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ABSTRACT

A 1982 survey of school superintendents provided much of the material for this discussion of the educational applications of microcomputers and other technologies, and for planning and developing these applications in schools. Chapter I is an interview with David Moursund, an educational computing expert who discusses issues and trends in school computer use. Chapter II describes a variety of applications and instructional programs and discusses changing definitions of computer literacy. Chapter III discusses technology planning theoretically and in several concrete instances, notably that of the Lexington Public Schools (Massachusetts); equity is noted as a growing concern. Considerations in computerizing--hardware selection and scheduling, budgeting, school staff roles and staff development, and software selection and design--are examined in chapters IV, V, and VI. Chapter VII outlines actual and potential administrative applications and offers advice on purchasing hardware and software for such applications. Special education applications are discussed in chapter VIII. Finally, chapter IX briefly explores other technologies, including cable television, electronic information networks, and videodiscs. (MCG)

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AASA Critical Issues Report

American Association of School Administrators

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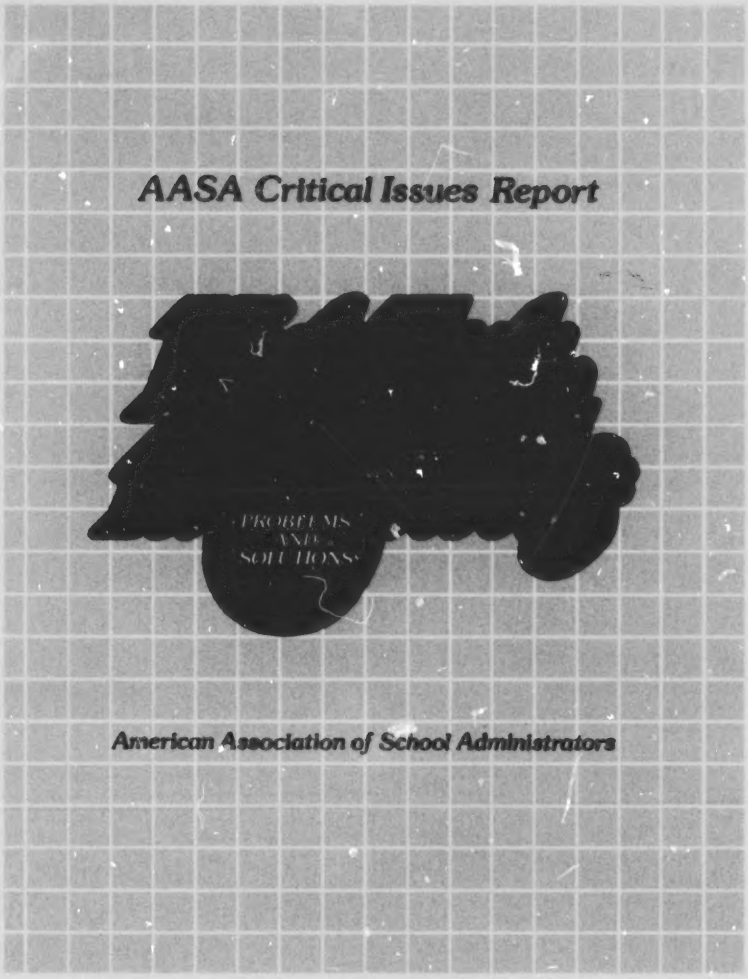

by Shirley Boes Neill

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The AASA Critical Issues Series

Many of the critical issues facing schools today are controversial. Seldom is there one best answer in dealing with these issues. What is best in one community may not be the best in another. That is why the American Association of School Administrators (AASA) decided to produce a series of Critical Issues Reports. These in-depth reports provide a wealth of information and ideas to help school administrators and school boards deal effectively with the challenge of assuring high quality education for students.

High Tech for Schools: Problems and Solutions is the 15th in the AASA Critical Issues Series. Like the others, it provides an analysis and reports successful practices and advice from authorities. Many of the concerns and ideas included in this book were shared with AASA through two nationwide surveys of superintendents and state education agencies. It is our hope that the information included in this publication will help schools plan and prepare for what they face in the years ahead.

Our thanks to those who helped make this publication a reality — computer teachers, specialists, and leaders; administrators who responded to our surveys and interviews; and many other people in computer and technology organizations and federal and state education offices.

The manuscript was written by Shirley Boes Neill, associate editor of *SchoolTech-News*, Sacramento, Calif.

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Introduction

The microcomputer has been variously described as a "one-in-several-centuries innovation," "the Swiss Army knife of the mind," an "information engine," "the electronic pencil of the 1980s," and the main force in a "technology revolution" now revitalizing education.

The "revolution" has been under way only a short time. Schools began acquiring microcomputers in the late 1970s.

Teachers and PTAs bought microcomputers; schools scrambled to take advantage of special discount offers on hardware and "give-away" programs; and districts overwhelmingly chose to spend much of their portion of federal "block grant" money to buy microcomputers.

The number of microcomputers in schools doubled between 1980 and 1982. But the large-scale movement of the hardware into the schools started in 1982-83.

The movement was clearly grass roots, with teachers leading the way. A single teacher often got the first microcomputer in a district, acquired some training and software, and "took the machine into the classroom to see what would happen." Teachers also began forming computer users groups to share information, strategies, locally developed software, and as one teacher noted, "to hold each other's hands as we tried 'this thing' out."

The teachers' enthusiasm was matched by events in the outside world. Youngsters became acquainted with computers in videogame parlors; many small computer and software companies became multimillion dollar establishments overnight; some parents who had computers at work (and some who didn't) saw the need to buy a microcomputer for their home. "Computer literacy" became a household word. New computer magazines announced hundreds of new add-ons and software for the machine, making it a "must have" tool in such diverse fields as agriculture and communications, art and banking.

A survey conducted for this report in the fall of 1982 revealed that few districts had a long-range plan or a board policy for using computers or formal guidelines to integrate them into the curriculum.

At the same time, however, virtually all of the administrators responding to the survey said they believed computers would have a tremendous impact on schools. A Mississippi superintendent said computers "would probably have more impact than any other technological development in this century." A California superintendent predicted the impact would be "extreme." He added: "It's not yet fully understood or even imagined by most of us."

A spate of national reports, issued between late 1982 and early 1984, gave the movement a big push by recommending that computing or technological literacy be added to the list of basic skills for all students.

Educating Americans for the 21st Century, issued by National Science Board Commission on Precollege Education in Mathematics, Science, and Technology, put it this way:

Our children could be stragglers in a world of technology. . . .We must return to basics, but the 'basics' of the 21st century . . . include communication and higher problem solving skills, and scientific and technological literacy.

That kind of warning helped make "Computer Literacy" — already a course or program in numerous schools nationwide — a concern of legislatures and state education agencies.

By 1983, schools had an estimated 200,000 microcomputers. By mid-1984, the number had jumped to 350,000. A revolution, or at least a major movement, was under way.

The Effects

The computer is responsible for bringing "the passion" back into education, says Bobby Goodson, a computer resource teacher for the Cupertino (Calif.) Union School District. She lists benefits for both teachers and students:

This movement is making teachers see that their role in education is changing. It's bringing excitement to education at all levels, starting with the six-year-old in the first grade class who gets good results at the computer, despite the fact that his native language is Arabic.

Robert Taylor of Teachers College, Columbia University, credits the computer literacy movement with the "self-renewal of dead faculty."

"We would have called this a miracle 2000 years ago," Taylor said. "Now, we call it a computer literate teacher."

On the other hand, some educators — veterans of other, earlier revolutions — decided to sit this one out. In interviews for this report, several of them said they were resisting inservice training in computer literacy, hoping to retire before the training became mandatory.

What about superintendents? Clearly, their support is needed, but often lacking, say some teachers and principals. One reason, according to one analysis: "The administrator is in the risky position of having to lead without personal experience."

Some administrators, moreover, are not sure how much attention this new movement deserves. According to one story circulating in Washington, a group of administrators requested a closed door meeting with a high federal education official. They wanted to know: "Is this computer revolution the real thing or only a fad?"

Some possible answers to that question come from several sources:

Linton Deck, formerly senior associate for advanced study, Vanderbilt University, told a House subcommittee that computers will come to play a central role in the public schools. Such a phenomenon occurs, he said, when a technology gains cultural acceptance, such as admittance to many homes, and when it becomes a primary work tool. Both of these conditions are being met. Approximately 4 million microcomputers were in homes by 1983. An estimated 25 percent of all U.S. households, moreover, contained at least one person who was using a personal computer at work or at school by early 1984.

Harold Howe II of the Harvard Graduate School of Education said he thinks computers are more than a fad — based on this fact: Most of them are in schools because a teacher became interested in having one around and acquired enough background to make use of it.

The Problems

According to one analysis, four things are required to assure the long-term use and effectiveness of computers or other technologies in schools: a "critical mass" of hardware, a sufficient supply of good software, teacher training, and continuing support.

Resolution of some of these problems is under way — in some cases, with the help of state legislatures. The state of Minnesota, for example, mandated district planning to deal with these problems in order to receive state aid for school technology programs. California and New York enacted similar legislation.

The Future

What could be the outcome of the movement of high tech into schools? Here are three views:

"...In the long run, electronic teachers may provide exchanges of information, ideas, and experiences more effectively than the traditional teacher." —Ernest Boyer, *High School: A Report on Secondary Education in America.*

"The technological tools that are developing, particularly in the software area, offer so much potential. ...The new technologies (e.g., videodisc) will provide universal access to high quality diagnostic and intervention procedures that have not been possible before." —Alan M. Hofmeister, formerly dean of graduate studies, Utah State University.

"I am becoming more and more convinced that what we have with us is the change agent that will make us look more seriously at curriculum as a whole." — Bobby Goodson, Cupertino (Calif.) Union School District.

Chapter I

An Authority Talks About Computers

David Moursund is a professor in the Department of Computer & Information Science, University of Oregon, Eugene. In addition, he is president of the International Council for Computers in Education, a nonprofit educational organization, and editor-in-chief of *The Computing Teacher* magazine. In the following interview, he discusses some of the problems and solutions in using computers in education:

Q. Are you optimistic or pessimistic about the future of computer use in K-12 schools?

A. I'm quite optimistic, and I've been impressed by the progress that is occurring. It's been a grass roots approach to change in education, and we haven't had such a thing that I've been aware of before. It's very impressive to see what happens when large numbers of teachers want certain types of changes and push for them. We've also had in a number of instances high level support from administrators such as principals. The top-down and the bottom-up approach working together can be very good.

Q. What differentiates this movement from other attempts to put technology into the schools?

A. The movement is much closer to the development of reading and writing . . . or the development of the printing press. . . . If you can imagine not having reading and writing at all, not having books, and bringing them into the school over a period of 20 or 30 years, that's the order of magnitude of the change we are talking about. We have had no experience with that kind of rapid change before.

Q. What is the key to this movement?

A. The home and universal usage are the keys. The standard estimate is that there are at least 10 times as many computers in people's homes as there are in the schools.

Q. Will the teachers and administrators who did not grow up with computers be able to adjust to this movement?

A. Yes. We all adjust to this type of change. Those who are my age adjusted to television coming in. A lot of us are learning to adjust to videotape recorders. We are capable of learning to adjust to computers also. We tend to get carried away with how frightening high technology can be, and we lose sight of the fact that we are educators and we understand the educational process. We are professionals in our field. What we have coming along is another tool. . . . If we can get past that first encounter and develop a little bit of familiarity, we can integrate that knowledge of computers back into our knowledge and again be the professionals that we are. . . . A computer doesn't undo what it is you are able to do. It doesn't change the need to have good skills in problem solving, in interacting with people, in planning. . . .

Q. A recent study found that some schools have only a few computers, yet they are using them only a small part of the day. Should administrators be concerned about this?

A. We are very rapidly making the transition from the computer being a scarce resource to the computer being an abundent resource. But we are hung up still on this concept that computers are quite expensive and difficult to have available. It's only a partially correct concept. . . . Let's take an example: We are not disturbed if a secretary uses a typewriter to type only one hour a day. It might even be a very fancy model that costs about $1,000 or so. So let's carry the same concept over to education. A student needs a computer. What's wrong if the computer gets used only an hour a day? . . . As the computer becomes cheaper and more readily available, then if you use it only an hour a day, fine. . . . If

there are situations in which computers sit idle for most of the day, most of it could be traced to relatively poor planning. . . . We shouldn't go out and buy computers and them try to figure out what to do with them. We should figure out what to do with them first and then, if it turns out that we need computers in the educational process . . . then buy the computers.

Q. You said, "if it turns out that we need computers in the educational process." Does that mean that some schools may not need computers?

A. There is a certain level of computer availability that one can justify universally now. If we look at what now constitutes a high quality, modern education . . . knowing what we know now about computers and the use of technology in education, any educated set of people would decide that all students needed some reasonable exposure to computers. They need what we call computer literacy. However you are going to achieve computer literacy, it's going to involve a substantial amount of hands-on experience . . . some knowledgeable teachers, some curricula, some courses. So . . . we need to think fairly carefully [about] how many computers we need in a fourth grade, or any grade. At any level, we need a systematic plan for how we are going to use computers.

Q. Should such a plan be made at the building or district level?

A. Probably both. A school system or even an entire state might decide on some computer related goals. An example would be a goal that the content of certain curricula ought to adequately reflect the capability of the computer as an aid to problem solving. . . . Once you come up with goals like this at a state or district level then it starts to become reasonable for districts or schools to think about how they are going to implement the goals. My general advice is that the better the cooperation at the higher levels, the better.

Q. Should district level planning precede building level implementation?

A. At this stage, we are often talking about closing the door after the cow is out of the barn. Computers are beginning to be readily available at the secondary level, so some planning obviously has already occurred. . . . Schools that have computers are already teaching some types of computer related courses. But as we look further into the future, we need to ask, how do we continue to add to this, what direction do we go, and so on. Districtwide planning then becomes highly desirable.

Q. Let's say you have only four computers in a high school, how do you make best use of them?

A. You have some goals in mind.

Q. In such a situation, what priority should you give to using computers for, say, math rather than for word processing?

A. If you have only a very modest amount of computer facility, then you set very modest goals. A very modest goal might be some modest level of computer literacy, where this is defined in terms like these: students will read a certain booklet; they will see a certain number of films; each student will have a modest number of hours of hands-on experience; they will see different types of software. You can work it down to very specific activities for all students. Many schools are very rapidly moving beyond this stage of having only three, four, or five computers. . . . If a number of faculty in a school, working in conjunction with the school administration, decide that using computers is important, then they allocate money that they were using for something else into computing. Say some of the typewriters are wearing out. If you have money to buy new typewriters, why not buy computer word processors instead? If some of the lab equipment needs to be replaced, get a computerized instrument. Once you get to the level where you have 30 machines in a school . . . then the issue is not nearly as tight.

Q. Is it better to locate microcomputers in a laboratory or in individual classrooms?

A. You have to plan how you want to use the machines. When you have only one or two machines, they tend to be dominated by the one or two teachers who caused those machines to be acquired. The machines would be located in the room or rooms of a very small number of teachers and used by those teachers specifically in what they are doing. When you start to expand and have a medium to large number of machines, then it is very clear that you want to have a separate room full of those machines — somewhere in which you can schedule classes or, when class is not scheduled, people can come in and work. As you expand, you can have both, small clusters in certain classrooms and a classroom set. Then it would be reasonable for teachers to have big monitors in the front of their room and one computer so that they could interact with their class and use the monitor as an overhead projector.

Q. Does the same advice apply to software?

A. When only one or two teachers are involved, they tend to have very little money to acquire software. So they acquire public domain software, which they put in their own small library. . . . As more computers and more teachers become involved, the teachers may start to get nervous about other teachers borrowing their software. Then there is a need for more software, and the school starts to use school money to buy it. When a school buys only two to five computers, it doesn't need to have clearcut goals. . . . When you buy a classroom set, you have in mind the goal of scheduling classes: word processing classes, computer programming, a simulation. The decision of what hardware and software you need is made simultaneously, as part of the planning.

Q. Are we still groping in the area of evaluation?

A. Yes, but we are making very rapid progress. We have the help of the organizations that do evaluations; we have very severe competition among the people developing software to develop better quality software, and we have a larger number of users who are reasonably sophisticated vis-a-vis software and who can say, 'yes, this does fit my kids,' or 'no, this doesn't fit my kids.'

Q. One expert said recently that whereas he considered only 5 percent of the software available a few years ago as very good, he would now raise that figure to 25 percent. Would you concur?

A. That's a generous, rapid increase, but he's basically correct. The rate of change you referred to — even if it might be overly optimistic — is reflective of some very rapid improvement in the quality of software.

Q. Should schools or districts try to design their own software to match their curriculum?

A. On the average, I would say no. . . . The cost of developing one quality piece of software could be quite large indeed. You can't recover this kind of effort for a piece of software that is going to be used only in one small school district. . . . The profit motive in nationwide distribution will cause people in some small companies to work 20 hours a day, seven days a week for years to produce quality software. School districts, on the average, cannot begin to match that, and it is not appropriate that they do.

Q. Should both the individual school and the district establish a position of computer coordinator?

A. When you have only a few computers in a school, you can take that out of the hides of the teachers who are concerned with computer use. When you have 30, 40, 50 computers in a school, taking care of that much computer equipment, supervising it, and making sure it is working, getting supplies, worrying about where the software is, and so on, starts to be a full-time job at add-on expense to the school. If you move up to the district level, and you have hundreds of machines, teachers at all school levels and in all the disciplines who need training, and software needs to be fulfilled, that is a full-time job.

Q. Will all teachers need to be computer literate?

A. Ultimately, every teacher is going to have to cope with computers in some way or other. It may be somewhat indirectly, but all teachers are going to deal with students who use computers all the time.

Q. Who should determine the level of computer literacy needed by teachers?

A. I think a reasonable approach to this, once some minimal level of schoolwide or districtwide training has been made available, is to help each teacher develop an individualized plan of gaining additional computer literacy. Ultimately, each teacher has to decide for himself or herself what level of knowledge about computers is required. Say I am an art teacher in a high school. Computer graphics work is going on; I know that computers are used in commercial art all of the time. What should I learn about computers? The principal can't come and tell me what I should be learning about computers in art. It's my job to remain professional in my field. The school district can help by providing me with an initial introduction to computers. But, ultimately, I need to develop my own plan and I need to have some help from the district in carrying out my plan.

Chapter II

Instructional Uses

New and emerging learning technologies, particularly computers and educational software, offer significant opportunities to deliver instruction effectively. In some cases, the incorporation of computer based instruction into the curriculum may have a revitalizing influence on the total instructional program.

A revolution in communications and information technology is making the computer a basic tool for acquiring knowledge, organizing systems, and solving problems. As such, it is having a profound influence on learning and on the world of work.

High expectations exist among parents, industry, government, and education that technology should be actively integrated into public school learning opportunities.

These three statements, issued by the state education agencies of New York, Wisconsin, and Minnesota, respectively, explain many of the reasons why schools are so actively struggling to incorporate technology, particularly computers, into the instructional program.

In several states, school districts have no choice but to offer students some form of "computer literacy" or computer education program. One survey, by *Electronic Learning*, revealed that three states and the District of Columbia require the testing of students on computer literacy skills. Fourteen other states, according to the survey, require or recommend that students develop some familiarity with computers.

Following three years of exploration and planning by a national task force, the College Entrance Examination Board decided to offer an Advanced Placement course in computer science for secondary students who intend to major in college in computer science or to enter other fields which require significant knowledge of computing. At the same time, the Board deferred the development of a description and examination in either computer literacy or computer awareness.

The AP course is expected to influence the design of other computing and math courses offered at lower grade levels for several reasons. The course, for example, requires the use of the Pascal programming language, although most K-12 programming activities use BASIC.

Other groups are also influencing schools in their pursuit of high tech. At least a half dozen much publicized, high level reports issued within about a 24-month period recommend that schools take full advantage of new technology. In many cases, emphasis on technology is tied to larger efforts to update curriculum, focus on higher academic standards, and better prepare students for the "information age."

Some examples:

- *A Nation at Risk*, probably the most publicized report of the early 1980s — the work of the National Commission on Excellence in Education — recommends that each student complete one-half year of computer science as a high school graduation requirement.

- The Educational EQuality Project of the College Entrance Examination Board put "computer competency" on a par with other basic academic competencies (e.g., reading, writing, math, reasoning) for students who intend to go on to college.

- The National Science Board Commission on Precollege Education in Mathematics, Science,

and Technology endorses one semester of computer science and general computer competencies for all secondary students as well as more advanced competencies for some students.

In *Educating Americans for the 21st Century*, the Commission said all students should acquire these competencies:

- Basic knowledge of how computers work and common computer terminology.
- Experience in using the computer as a tool, (e.g., word processing and filing systems).
- Ability to use one high-level computer language as a means of interacting with the device.
- Ability to use a computer language to do problem-solving tasks.
- General understanding of the issues confronting society in the use of computers.

The Commission said students with special interest in and ability for computing and those who may pursue further study in scientific and technical fields should have:

- Thorough knowledge of how computers work.
- Experience in using the computer as a tool, particularly for applications such as text editing, computer-assisted composition, computer-based statistical analysis, simulation, data logging, and manipulation . . . and common computer utilities.
- Knowledge of at least two computer languages, with an emphasis on appropriate problem-solving skills and development of readable, structured programs.

School Uses of Computers

How can schools use computers in instruction? What's possible?

Probably the most popular explanation of educational uses of computers is that given by Robert Taylor of Columbia University. A computer, Taylor said, can be used as a tutor (in Computer Assisted Instruction or CAI), as a tool (for word processing, calculation, statistical analysis, data retrieval, simulation), and as a tutee (in which the student programs the machine).

Many other explanations of computer use can be found in the literature. The National Science Board Commission on Precollege Education in Mathematics, Science, and Technology, for example, describes three categories:

- **Learning about computers.** In a beginning stage, computer literacy is simply learning about computers — how to use them and how they benefit society, the Commission said. At a more advanced stage, computer literacy includes computer programming.
- **Learning through computers.** The Commission's examples include: drill and practice, diagnostic testing, and question-and-answer tutorials.
- **Learning with computers.** Examples: educational games which develop reading comprehension and problem-solving skills; microcomputer-based instrumentation systems which permit explorations of real-world phenomena; databases to increase information available to students; tools, including graph-plotting routines, word processing, spreadsheet programs; special purpose computer languages like Logo; simulations; and discovery learning in mathematics.

School Practices

The amount of hardware available to a school often determines how it is used. Other factors affecting usage include: amount and type of software and other resources, the length of time the school has had access to the hardware, the number of trained staff, and district policy and leadership.

In the fall of 1983, U.S. schools owned 325,000 microcomputers, up from half that number one year earlier, according to Market Data Retrieval. Only about one out of seven school districts (14 percent) did not have at least one microcomputer for instructional purposes, according to the organization. It added that more schools (55,000 of them) were using microcomputers in 1983 than in all prior years combined.

Broken down by grade levels, 62 percent of elementary schools were using microcomputers, as were 81 percent of junior high schools and 86 percent of senior high schools. The average senior high, according to Market Data, had 11 computers, the average junior high had 7, and the average elementary school, 3.5. It noted that "hundreds" of high schools already had 25 or more microcomputers available for instructional use.

Uses. Administrators responding to the survey for this report said the top instructional uses of microcomputers in their schools and districts were: computer awareness, computer programming, enrichment, drill and practice, games, remediation, simulation, and word processing.

Another more comprehensive study, conducted by Henry Jay Becker of Johns Hopkins Uni-

versity, Baltimore, analyzed data from 1,082 microcomputer using schools that obtained one or more micros for instructional use prior to January 1983.

In the typical microcomputer-owning elementary school, Becker said, students spent the instructional computer time in these ways: practicing math and language facts, spelling drills, and various other memorization tasks (40 percent of the time); copying, writing, and testing computer programs (33 percent); playing drill-and-practice learning games (most of the remaining time).

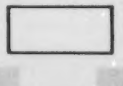
Becker said the elementary students included in the study did not spend sufficient time on the drill-and-practice activities for any appreciable skill building to take place. Thus, he concluded, the primary consequences of the drill and practice "may be an increased understanding of computers themselves [that is, computer literacy] rather than subject matter learning."

In the typical microcomputer-owning secondary school, programming and computer literacy activities occupied two-thirds of the computer instructional time. Drill-and-practice activities accounted for another 18 percent, with the remainder split among learning games, advanced applications (e.g., word processing, science lab work, business courses), and other activities.

What Is Computer Literacy?

Most districts today have a course or program called "computer literacy." The content and focus of these courses and programs, however, vary from district to district and even from school to school within a district.

Interviews, studies, and publications reviewed for this Critical Issues Report indicate that a



Help, Hindrances to Computer Literacy

"Developing a computer literate school is a complex process" — one that requires attention to many details, according to Beverly Hunter, et al, in their report of a year-long experiment to incorporate computer literacy into the curriculums of six schools in Montgomery County, Md., and Alexandria, Va.

Writing in *Phi Delta Kappan,* Hunter says the experiment showed that these factors encourage computer literacy:

- Giving teachers access to adequate amounts of equipment, many different kinds of software, and technical assistance.
- Making media specialists responsible for managing equipment and for acquiring, cataloging, and circulating software.
- Providing a large amount and a wide variety of inservice training, tailored to the individual needs and interests of teachers.
- Administrative support and leadership.
- Student enthusiasm. "Many teachers were reassured to discover that students could help one another, instead of relying solely on teachers as the experts," Hunter says.

Other factors work against the development of a computer literate school. "The most complex of these factors," Hunter says, "is the difficulty of integrating new tools into an existing curriculum.

"It is hard enough," she explains, "just to find software and other computer materials that are educationally sound and developmentally appropriate for a particular group of students; nonetheless, a further obstacle exists: materials that we do find often fail to fit into our curriculum plan."

Hunter also notes that many of the skills that computers teach best are not included in the curriculum, and they must either replace existing materials or be ignored.

Another obstacle, in Hunter's view, is the inflexible work day of teachers, "which does not allow them time to experiment with new machines, to search for appropriate software . . . or to perform a myriad of related tasks."

What were the results of the experiment? Three of the six schools made "amazing" progress toward becoming computer literate, according to Hunter.

computer literacy program is sometimes a single course taught in one grade. Students may simply learn *about* computers and their uses. Or they may spend most of the available time using the machines. At the other end of the spectrum, a computer literacy program may include different activities at different grade levels (e.g., drill and practice for some students and enrichment activities for others in the early elementary grades, computer awareness and introductory programming at the middle school/junior high level, and elective courses in, say, programming at the senior high).

Defining computer literacy and the desirable elements of a computer education program presents a major challenge for districts or schools that are trying to develop a computer literacy course or to move to a more comprehensive program.

One important point to keep in mind is that the concept of computer literacy is changing. "Historically, computer literacy tended to refer to an awareness level of computer knowledge," notes David Moursund in *School Administrator's Introduction to Instructional Use of Computers* (International Council for Computers in Education, University of Oregon, 1787 Agate St., Eugene, Oreg.; $3).

"Students would read about computers and learn about their capabilities, limitations, and applications," Moursund says. "This point of view was strongest when computers were still quite expensive, and it was not feasible to make hands-on experience available to most students."

"Nowadays," Moursund continues, "the goal of universal computer literacy focuses on a functional level of knowledge about using computers. Part of this is easy to obtain; for example, learning to use library programs to help solve problems is possible even at the lower elementary school level. . . . Moreover, studies have shown that any student use of computers leads to increased computer awareness and knowledge of computers."

The difficult part of making students literate, Moursund says, is in having them develop a useful level of programming skill. This takes a substantial amount of instruction and practice. "Freshman level university students find that it takes a half year to a full year course to obtain this level of programming skill," according to Moursund.

Following is additional guidance from various sources to help schools develop a computer literacy program:

Federal Definition

A 10-person advisory panel for the federal National Center for Education Statistics adopted this definition of computer literacy in late 1983:

"Computer literacy may be defined as whatever a person needs to know and do with computers in order to function competently in our information-based society.

"Computer literacy," the panel said, "includes three kinds of competence: skills, knowledge, and understanding. It includes:

"1. The ability to use and instruct computers to aid in learning, solving problems, and managing information.

"2. Knowledge of functions, applications, capabilities, limitations, and social implications of computers and related technology.

"3. Understanding needed to learn and evaluate new applications and social issues as they arise."

In a report on the project, the panel said: *This definition highlights the fact that specific skills, knowledge, and understanding will vary from person to person, from job to job, and from time to time. The term, "computer literacy," does not, however, cover the specialized knowledge and skills that are required for careers in such computer related fields as computer science, data processing, or systems engineering.*

Note: The project developed pools of 200 computer literacy test questions for each of four specific groups: superintendents, principals, teachers, and students. "The surveys that can be developed from the questions are intended to provide data that will be useful to school officials in planning teacher training programs, curriculum, and the development and evaluation of hardware, software, and related learning materials," noted project director Marlaine E. Lockheed, a research sociologist for the Educational Testing Service. The final project report is entitled *Computer Literacy: Definitions and Survey Items for Assessments in Schools.* For more information, contact Richard M. Beazley, National Center for Education Statistics, Brown Building, Room 600, 400 Maryland Ave., S.W., Washington, D.C. 20202.

Advice from the Experts

The New York State Education Department surveyed 14 experts in an attempt to determine what a computer literacy program should contain. The results are published in *Computer Literacy: An Introduction* (Center for Learning Technologies, State Education Department, Cultural Educational Center, Room 9A47, Albany, N.Y. 12230; 1982; $6).

Here are excerpts:

Q. What should be included?

A. Hands-on experience, computer awareness, and other elements.

"All those canvassed stated that hands-on experience with a computer was the most important of the many possible features of a program of computer literacy. There was no consensus on the proportion of the program that should be devoted to hands-on experience. However, most of the persons agreed that there should be opportunities both for programming and for applications.

"Most of the persons recommended, with differing degrees of emphasis, that students become aware of the social impact of computers, the history of computers, and information on computer hardware." Two of those surveyed felt that these topics should be labeled "computer awareness" rather than computer literacy, and that by themselves, they would not be enough to achieve what these persons consider to be computer literacy.

Q. How early should computer literacy begin?

A. "The majority of the persons stated that some form of instruction in computer literacy should be started as early as possible. Two suggested that preschool children could benefit from experience in using computers; four suggested that students should begin using computers in either kindergarten or first grade. One person opted for beginning formal instruction in computer literacy in the fourth grade; another chose the fourth through the sixth grade. Four of the persons would hold off such instruction until junior high."

Q. Should computer literacy be a separate course or integrated with other subjects?

A. Most of the persons surveyed said students should have some direct exposure to a program of computer literacy; however, none were op-

AASA Respondents Gauge Impact of Computers

"How much impact will computers have on schools in the next decade?"

"Tremendous." That was the most frequently used single word answer given by respondents to the question in the AASA survey for this report.

Many of the respondents said the largest impact would be in instruction; some specifically mentioned Computer Managed Instruction. Some respondents equated future impact with the availability of suitable software and adequate finances.

Here are some of the specific responses:

"[With] 1 being the lowest, 10 being the highest, [the impact of the computer will be] 9+." — Bert Hageman, Superintendent, Erie (Ill.) Community Unit Schools

"The impact will be revolutionary. Computer literacy will rival reading literacy." — Walter L. Powers, Assistant Superintendent, School District 271, Coeur d'Alene, Idaho

"Perhaps the greatest impact ever in educational change." — Bill Brown, Superintendent, Byron (Ill.) Community Unit School District

"Tremendous impact as the price of microcomputers falls, and they become affordable by families." — Michael Pavlovich, Superintendent, Alden (N.Y.) Central School District

"More than any previous technological advance." — Roy D. Nichols Jr., Superintendent, Marietta (Ga.) City Schools

posed to a broad exposure to computers throughout the curriculum.

Here are additional views on what the focus of a computer literacy program should be:

View #1: Focus on what is needed now. "This is a transitional period for students, teachers, and education. We do not have sufficient information to determine all of the necessary competencies or even the best uses of technologies. We need experience, and we must learn to use all that technology has to offer to improve the educational process," Bobby Goodson, computer resource teacher for the Cupertino (Calif.) Union School District, noted in a paper prepared for the 1983 National Educational Computing Conference.

"In 10 years," she said, "there may be no need to develop an understanding of computer jargon; whatever is needed will be common knowledge. Computer history will be part of general history. The common uses of computers will be as well understood as the uses of a car today. Programming as we know it may not even exist.

"In this transitional period," Goodson noted, "it is essential that all students be alert to the real changes that are occurring. . . . They must not continue to make conscious, and unconscious, decisions about their future based on outdated ideas. Sufficient contact with technology in its many forms may help them choose to take more math and science than they might have otherwise. Or they may continue in another line altogether, but we will have given them the opportunities needed to make a considered decision."

Goodson said students need opportunities to see the computer as a tool rather than as an object of study. "Young students need to become familiar with the keyboard, a mouse, and any other commonly used input device. They need to learn how to select and use software suited to their needs.

"Slightly older students need to be introduced to the computer as a creative tool (e.g., a word processor, calculator, and problem analyzer)," she said.

What will students need to know about computers in the 1980s? Goodson's answer: "They certainly need to be comfortable interacting with a computer. This may mean using a variety of input devices. It certainly means being able to read, understand, and respond appropriately to what appears on the video display. For the next few years, secondary school students will need to . . . develop an understanding of the appropriate uses and the limitations of technology [and] . . . of the changes that are occurring in industry and in the professional fields that interest them."

Many students, Goodson said, will need to learn more about computers and the languages used to work with them. No single language," she noted, "can be regarded as *the* language for all students. For many students, the discipline of learning and working with a computer language will offer the same values their grandparents derived from learning a foreign language. It is a thinking, understanding, mental tool.

"All secondary students," she added, "will need to have access to the technological tools that will be available to them beyond their schoolroom. This certainly includes computers as calculators and word processors, computerized databases as research tools, and computers as tools for problem solving in science and math."

What about middle school students? Goodson said: "All students need to be introduced to the use of the computer as a tool. . . . If students understand . . . and can interact with a computer at this level, the applications can be taught in the appropriate subject areas in the high school."

View #2: Emphasize programming. Arthur Luehrmann, head of Computer Literacy Co., Berkeley, Calif., and author of a popular textbook on programming, is perhaps the country's most outspoken advocate of formalized instruction in programming for all students.

In numerous appearances before technology conferences and in his writing, Luehrmann argues that the "backbone" of any computer literacy course that's teachable today is programming.

Critics of this approach, Luehrmann says, equate programming with a vocational course and "they ask how many people are really employable as programmers." He counters with arguments like these: "We spend 12 whole semesters teaching kids to write, yet most of them won't earn a living by writing. Programming is just writing for the computer. . . . It is an intellectual skill — one that teaches the important skills of planning, organizing thoughts, breaking a problem into manageable parts, working on one piece of a problem, expressing ideas, using them to solve problems, and learning how to revise. Computer languages are an appropriate vehicle for teaching reasoning skills, and that is the bottom line."

He advocates that all students receive at least one semester of programming, with some students taking more. The language that students should be taught, he says, is BASIC, because it is so prevalent on the machines used in schools.

"No single language is ideal for beginners," Leuhrmann told one technology conference. "Not even Logo is perfect. And with Pascal, the student has to learn about variables right away." BASIC, he noted, can be taught well or poorly just as English can be taught well or poorly.

When to offer computer courses. "About the first time you can get a computer course into the schools is junior high, because it is the first time you have subject matter teachers and can have a slot in the curriculum," Luehrmann said. "Only by having a computer teacher with a specific course can we get computers into the regular curriculum." In such a course, students should be taught not only programming but also use of already prepared software, he added.

What follows a computer literacy course? "It's hard to tell," Luehrmann said. "About one-half of students who take a first-semester course will go on to a second semester. About half of those will go on to a computer science course or data processing. So, 25 to 30 percent would take four semesters of computing; 50 percent would take two semesters."

What if programming languages die out — would students have wasted their time? "No," Luehrmann said. "The main idea of learning to program is learning to plan, organize, revise your ideas."

View #3: De-emphasize programming; concentrate on the "big five" computer applications: word processing, telecommunications, database management, spreadsheets, and graphics.

"In most high schools, computing remains almost synonymous with the teaching of programming languages, despite the fact that outside of school, the vast majority of computer users are not programmers," notes Martin Schneiderman, director of the Technology Laboratory for the Educational Testing Service (ETS), in *Computer Literacy,* an ETS publication.

Several additional arguments against programming, as it is currently taught in high schools, come from Alfred Bork, director of the Educational Technology Center, University of California, Irvine.

"The major problems," he said in an interview with *SchoolTechNews* newsletter, are "misguided" programming courses and too many untrained teachers. The "major villain in weak high school programming courses," he noted, "is the programming language BASIC."

"Students who come out of high school programming courses often arrive at the university at a distinct disadvantage compared to students who have not taken programming in high school," he noted. "Many of them learned so many bad habits and are so immersed in inferior languages," he explained, "that they can't graduate to an adequate programming background."

On the positive side, Bork endorsed the new Advanced Placement exam in computer science (administered for the first time in May 1984). The exam requires knowledge of the language Pascal, not BASIC. According to Bork, "it begins to show secondary schools where the programming standards are in universities."

Bork also criticized the many computer literacy programs that "teach a little bit" of many different languages and the way in which the programming language Logo is taught in many schools. The UC professor said he and his staff have visited many schools using Logo "and what we see is usually a disaster. . . . It's so far removed from the intent of Logo."

Bork placed much of the blame for poor programs on inadequate teacher preparation, sometimes combined with poor curriculum materials.

Computer literacy is taught more effectively, according to Bork, in standard curriculum areas, such as math, English, and science. "That's why I think word processing is eventually going to be very important in schools." He advised that word processing "needs to occur within the context of a class and should not be taught by itself."

Computer education teacher Dan Gaydosh, Cary-Grove High School, Cary, Ill., believes only about 10 percent of the student population really needs programming skills. Writing in *InfoWorld,* Gaydosh says the only programming needed by the majority of the student body might be some demonstration programs in a computer awareness class.

Instead, he recommends, "what should be taught in the high schools is a software survey course which exposes students to word processing, databases, spreadsheets, and personal accounting. In this way," he notes, "children are armed with the techniques to make computers really work."

View #4: Incorporate computer literacy topics

into all areas of the curriculum. This suggestion comes from Donald Rawitsch, director of user services for the Minnesota Educational Computing Corp. He believes this is a better approach than teaching computer literacy in a single class at a single grade level.

"The total approach," he noted, "means that all teachers will have a stake in implementing the technology; therefore, it will be more successful."

What topics should be included? Rawitsch says each district should figure out what computer literacy is in terms of its own needs.

Speaking before the 1983 National Educational Computing Consortium, Rawitsch suggested that districts start by defining the *outcomes* they expect in a computer literate student and then figure out the *component* to achieve each outcome.

Rawitsch offered these examples:

Outcome	Component
1. Students should be knowledgeable about the role of computers in society.	Teach how computers are used.
2. Students should be self-sufficient in use of computers.	Teach how systems are operated.
3. Students should be in control of computers.	Teach use of computers, e.g., in word processing.
4. Students should not be intimidated by technology.	Teach that computers are simply machines.
5. Students should be aware of problems with technology.	Teach how computers impact society.

Tips: Rawitsch said he does not advocate spending equal time among all components; also, that decisions makers may decide to leave out some things (e.g., history of computers) if they cannot identify an outcome for students.

Note: For more information on this approach, see *Establishing Instructional Computing: The First Steps* (Phi Delta Kappa, Eighth and Union Sts., Box 789. Bloomington, Ind. 47402; $1.50).

Guidelines; Models

The North Carolina Department of Public Instruction recommends to local districts the adoption of a computer literacy program that includes the following seven elements:

- Activities to overcome negative attitudes or fears.
- Definitions of computer terms.

Noteworthy Instructional Uses of Computers

Many options are open to districts that are ready to move beyond teaching students about computers. Here are some of the possibilities:

Science: Simulation of complex processes; collection and analysis of data from experiments; student generated problems via computer.

English: Creative writing with word processing.

Social Studies: Access to national databases for current information and research on special topics; simulation of economic systems.

Mathematics: problem solving; simulation of functions; study of the behavior of curves via computer generated graphics.

Electronics: Learning about computer circuitry and repair methods.

Music: Composition of computer-generated music; study of tones and rhythm.

Art: Computer-generated designs.

Architecture: Computer-design of structures.

Career Guidance: Computer access to career information for all students.

Accounting: Learning to use computer programs such as Visicalc, which provides an accounting worksheet with great flexibility.

Primary classes: Logo, a graphics-oriented programming language.

Source: Grayson H. Wheatley, director, graduate research in mathematics education, Purdue University.

- Familiarity with basic components of a microcomputer.
- What a computer and computer program can and cannot do.
- An introduction to computer programming.
- Sources of information about computers and computer software.
- Impact of computers on society.

The agency stresses the need for flexibility at the local level, noting that computer literacy programs will vary from school system to school system.

A sample curriculum guide developed by the Department breaks computer literacy into three areas: computer awareness (grades K-5), computer exploration (grades 6-9), and computer specialization (grades 10-12). The Department includes suggested objectives, activities, and implementation for each area.

Among the recommendations included in the guide are the following: that Computer Assisted Instruction be used at all grade levels; that students be introduced to programming in Logo or BASIC in grades K-5; that students take a computer literacy unit or semester course as part of computer exploration (grades 6-9); that an "Introduction to Computers" semester course be offered as part of computer specialization (grades 10-12); and that programming and data processing courses also be offered to students in grades 10-12, particularly to business and math-science oriented students.

Model: Computer Literacy in Lower Grades

The International Council for Computers in Education (ICCE) outlined five different types of knowledge that comprise computer literacy for students in the lower grades. In *Computer Literacy Activities for Elementary and Middle School Students,* ICCE says all students at these grade levels can learn:

- To operate a computer, i.e., turn it on, and select, load, and run a program.
- To understand how computers relate to a variety of subject areas and various roles outside of education.
- To direct a computer to aid in writing, information retrieval, music composition, and creative art. (If appropriate computer facilities are available, the booklet adds, all students can learn to write simple programs in a language such as Logo.)
- Algorithmic processes and algorithmic thinking.
- Computer-oriented vocabulary and the general capabilities and applications of computers.

For more information, see *Computer Literacy Activities for Elementary and Middle School Students,* available from ICCE, 1787 Agate St., Eugene, Oreg. 97403; $5 prepaid.

Model: Secondary Computer Science Course

The Association for Computing Machinery recommended a year-long computer science course, roughly at the level of a high school biology course.

Such a course (32 weeks in length) is outlined in *An Introduction to Computing: Content for a High School Course* (ICCE, see address above; $2.50 prepaid).

The course contains seven units: General Introduction, Using Computers for Learning, Information Retrieval, Computers in Creative Arts, Modeling and Simulation, Artificial Intelligence, and Conclusions. The booklet includes suggested applications, programming activities, and tips for the teacher.

The course requires some computer equipment, some "good" demonstration software programs, an "interactive computing environment," and an adequately trained teacher. Course designer Jean B. Rogers suggests that the teacher have a background that includes at least eight or nine term-length (quarter system) undergraduate level computer science courses, or the equivalent in self-taught knowledge.

Model: AP Course

The goals of the Advanced Placement Computer Science course are intended to be comparable to those of a first year course offered by college and university computer science departments.

"A primary objective of the course," says James S. Braswell of the Educational Testing Service, "is to teach students how to write logically structured, well documented computer programs.

"The course is more than a course in computer programming in the narrow sense of that term," he adds. "Computer science, or computer programming in the wider sense, encompasses the collection of technical skills and scientific methodologies used in the creation of high quality

computer-based solutions to real problems."

The course, he notes, "is highly symbolic, demands strong problem solving skills, and emphasizes the need to structure and develop solutions in a logical manner."

Before attempting the AP course, schools must provide extensive preparation of teachers (and students).

Braswell explains: "Most secondary schools will not find it easy to get started in AP Computer Science. For many prospective teachers of the course, it will be necessary to learn a new language, Pascal, as well as various computer science topics mentioned in the outline of the course."

Note: The College Entrance Examination Board offers several publications to help schools and teachers interested in teaching the AP course: *Advanced Placement Course Description: Computer Science* ($5) and *Teacher's Guide to Advanced Placement Courses in Computer Science* ($5). Order from the Board, Advanced Placement Program, Box 2899, Princeton, N.J. 08541.

Model: Total Integration

How can education make maximum use of new technology? An option that some districts are pursuing as they acquire hardware, experience, and trained staff is total integration of computers into the existing curriculum.

One model for pursuing this approach comes from the New York State Education Department's Center for Learning Technologies (Cultural Education Center, Room 9A47, Albany, N.Y. 12230).

In its publication, *Getting Started: Planning and Implementing Computer Instruction in Schools* ($6), the Center outlines four steps in the integration process:

1. Develop broad goal statements, that is, specify what you want students to know about computers and be able to do with them. These broad goals become the organizing framework for the curriculum.

In developing the goals, the Center suggests that districts consider the three broad categories proposed by Robert Taylor: using the computer as a tutor, as a tool, and as a tutee.

2. Develop specific student competency statements, based on the broad goals developed in step 1. These statements should indicate "what you believe students will need to be able to do with computers in continuing their education and in work," the Center advises. Keep in mind that the statements may have to be updated regularly to reflect rapid changes in technology. You may also wish to develop statements relating to student attitudes about computer applications (e.g., the limitations of the computer).

3. Develop curriculum objectives. This step links the broad goals and the competency statements to the existing curriculum. "The linkage is made," the Center says, "by assigning each statement to one or more subject matter areas and modifying it to reflect the specific computer application that will be made in that subject area."

Here are two examples:

Social Studies — "Students will be able to use graphics software to prepare charts and graphs illustrating various characteristics of society."

Mathematics — "Students will be able to use the Logo programming language to calculate and draw various geometric shapes."

The Center offers this advice to curriculum planners: A contemporary statement can be linked to more than one subject matter area; it can be introduced at several grade levels (depending on the availability of equipment, instructional materials, and trained staff); it may or may not be appropriate for different students. Regarding the latter, the Center notes, for example, that a curriculum committee will need to judge whether all students should be required to learn programming.

4. Develop instructional strategies and applications. In this step, the classroom teacher specifies the instructional approach (e.g., tutorial or simulation, large group or individual), the instructional objective, and the student performance measure. The Center notes that the curriculum planning committee probably will not proceed with this step until other planning stages (i.e., staff development and material acquisition) are completed. It also advises that a major portion of staff development activities should concentrate on this step.

Tips from the Center:

- "The integration of computer competencies into the curriculum will require special attention to the traditional problems of articulation across grade levels and subject areas."
- Districts may want to develop the curriculum from the top down, that is, starting at the secondary level, because of limited resources and the need to prepare those students who are graduating.

Pros and Cons of CAI

Computer Assisted Instruction (CAI) "has potential for improving instruction in schools; however, care must be taken to avoid the potential problems."

That caution was issued by Grayson H. Wheatley, director of graduate research in mathematics education, Purdue University, in an article in *Educational Computer Magazine* (September 1983).

Wheatley notes these pluses: "It is now well established that the computer can be a patient tutor ... it is useful to students wishing to pursue an advanced course not offered in their school ... it is useful in assisting the slow learner ... it can be an effective way for all students to learn."

On the other hand, Wheatley says, "a curriculum that makes heavy use of CAI in all likelihood will emphasize low-level skills." He offers this example: "It is much easier to write a CAI lesson that provides practice in spelling or adding decimals than one that teaches critical thinking or mathematical problem solving."

Other problems cited by Wheatley: (1) Students using this mode of instruction may sit at the keyboard for long periods of time; thus, CAI may monopolize computers. (2) The lure of CAI may be strong for an untrained staff because it requires little knowledge of computers. Thus, he says, it may hinder staff training and interfere with the development of a comprehensive computer education program.

A summary of the views of both proponents and opponents of CAI comes from David E. Hawley, a graduate research assistant, writing in *Computers in Education: A Practical Guide for the School Administrator* (Oregon School Study Council, 1787 Agate St., Eugene, Oreg. 97403; $4). He says:

"Those in both camps agree that the usefulness of CAI depends directly on the amount and quality of courseware available and on the extent to which it addresses the needs of a particular curriculum. Further, they concur that if CAI becomes an integral part of pedagogy, school administrators will need to modify the traditional bases for supervision and evaluation of teaching."

Note: Information on this approach is contained in the Center's publication (listed above). A more detailed explanation of it is also contained in *Computer Applications Planning*, published by the Technology Lighthouse of the Merrimack Education Center, Chelmsford, Mass. (See the chapter on Planning.) This publication advises, for example, that a district should set priorities for implementation among desirable student competencies (step 2 above) because of limited time and resources. Criteria that can be used to do so, according to the publication, include: student need, the availability of appropriate technology, cost, and staff readiness and commitment.

Also see the case study on the Lexington, Mass., schools in the chapter on Planning.

Case Study: Cupertino, Calif.

The Cupertino Union School District acknowledges in its guide, *Computer Literacy Curriculum, K-8* (1984 edition), its high priority on computer literacy as the first instructional use of computers. It adds, however, that the entire thrust of the personal computing industry is toward making the machines easier to use. Thus, it concludes, "we are inevitably moving toward needing to know less and less about computers. As a result, computer literacy may prove to be short lived."

It is this philosophy that leads Bobby Goodson, computer resource teacher for the district, to call Cupertino's 7-year-old program an "evolutionary" one.

The district also considers its computer literacy curriculum "flexible" — one that may need to be adapted differently in different schools based on the strengths of staff, the configuration of computers and their locations, and how they are used.

The curriculum guide offers suggested grade levels for 22 pages of skills that are to be intro-

duced, reinforced, given advanced work, and mastered.

The skills are grouped into seven areas, as follows, with an example of an objective in each area:

- Computer awareness (e.g., "explain how a computer works").
- Computer interaction (e.g., "demonstrate the use of a prepared program, including the ability to stop, escape from, and continue as needed").
- Programming (e.g., "write simple procedures in Logo").
- Language arts (e.g., "use a computer as a word processor").
- Mathematics (e.g., "use the computer to organize mathematical data").
- Social studies (e.g., "identify ways the computer can aid in locating, organizing, and applying information").
- Science (e.g. "apply the scientific method: gather facts, formulate a hypothesis, test the postulate, and make a conclusion").

Goodson asks teachers to incorporate computers into what they are doing. She believes the district's curriculum is especially adaptable to this approach. To illustrate: one of the aims is to have students learn a computer vocabulary of 179 words. "We want those words to be put in with the regular spelling list," she noted. Two other objectives call for students to learn to use a simulation game and the keyboard. Goodson said a teacher could have students practice on the keyboard while using a simulation in social studies class, thus taking care of two objectives at one time.

Most of the district's computers are located in labs; some are placed on carts within the labs for easy movement to a classroom. Aides work in the computer labs with the students. Goodson said she does not particularly like this approach because the teachers don't have to get involved with computers. "I would prefer that it not be done this way, but it is working and the kids are getting things they were not getting the other way." Some teachers, she added, bring the computers into their classrooms on mobile carts for specific applications, in addition to sending their students to the lab for instruction.

Gaining the involvement of teachers, particularly at the junior high level, can be difficult, Goodson noted. One reason: The machines are mainly occupied with lab activities, so they are not generally available for subject matter teachers to bring into their classes. "Until we get at least 10 additional computers in each junior high, I don't think we are going to get the involvement in science, social science, and language arts that we would like."

Advice to other districts: Goodson advises districts to build slowly toward a comprehensive approach, expecting to modify and adapt as they go — and as the technology changes. "Part of the strength of our program," she said, "is the fact that it has taken us seven years to get where we are.

"When other districts want to model their program after ours, I tell them to take what they want, to adapt it, to try it out in, say, two schools to begin with, and then to add two more. My point," Goodson said, "is that you have to move slowly. You have to adapt the program to each locality, each building, each staff.

"Some schools," Goodson noted, "start off trying to teach beginning Logo to all grade levels in the first year of their program. We need to break concepts into little, grade-level segments and teach them that way, admitting that some students are going to slip through the cracks in the first few years. Some fifth and sixth-graders will leave our schools, for example, without all of the experiences we would like them to have. You cannot avoid that.

"The lesson to remember," she added, "is that you may not hit every kid with every lesson the first two or three years you have a new program. It's like when we are looking at software, and teachers say, 'I can't do all of this; it's too much.'" Goodson advises them: "Don't worry about all of it. Find one piece that fits what you teach the way you teach it. Incorporate that one piece into one set of lessons. Do it well; develop some worksheets or whatever you need to make it a total lesson. If that is the only thing you do with computers all year, you will have been successful."

A teacher can handle that, Goodson noted. "Then, they will come back the following year for another piece of software they can use. The successful experience leads to a desire to tackle another one. If, instead, I were to advise them to use the computer once a week every week in their classrooms, it wouldn't happen."

Principals' participation. During the first five years of Cupertino's program, principals were not involved generally in school computer activities. But in 1983 and 1984, they became much more involved, according to Goodson.

"They are asking for training," she said, "because a lot of our schools now have one microcomputer in the office. Several of the principals have mastered word processing and PFS (a database software program), and they are using them to do their administrative work."

Note: Cupertino's *Computer Literacy Curriculum, K-8* is available for $7.50 per copy from the district (10301 Vista Dr., Cupertino, Calif. 95014).

Local Programs

School administrators can look to an increasing number of schools and districts nationwide for examples of effective uses of computers and other technology for instructional purposes. Some are receiving support from private companies; others depend on local, state, and/or federal funds.

In the latter category are 29 projects which receive at least part of their funding from the U.S. Department of Education's National Diffusion Network (NDN).

All NDN projects are evaluated and approved for national dissemination by a federal review panel. NDN makes possible the "adoption" of these projects by districts and schools at low cost. (For more information, contact Lee Wickline, Director, National Diffusion Network, Brown Building, Room 613, 400 Maryland Ave., S.W., Washington, D.C. 20202.)

The NDN technology projects include:

Project COFFEE
Focus: Occupational education
Contact: John Phillipo, Project Director, Oxford High School Annex, Main St., Oxford, Mass. 01540

This is an alternative occupational education program for alienated youth. Started in 1979, the project has attained a 96 percent success rate in enabling potential dropouts to graduate from high school. The project works with the school district, Digital Equipment Corp., and state and local social service agencies in enabling students to complete the four parts of the program: basic skills instruction, occupational training, individual and group counseling, and physical education. Students may choose from five different types of occupational training, including: *data processing* (entry-level training as computer operators, programmers, service technicians, and data entry operators) or *electronic assembly* (training in the layout, manufacture, and assembly of printed circuit boards with electronic components).

Digital Equipment's contributions to the project include: providing 50-50 matching funds for hardware purchases, training project teachers in electronic assembly and computers, and providing demonstrations and field trips for students.

Computeronics
Focus: Computer literacy
Contact: Diane Johnson, Leon County School Board, 925-A Miccousukee Rd., Tallahassee, Fla. 32304

This is a 35-40 hour course in programming, problem solving, and computer literacy originally developed for gifted and high-achieving students in grades 6 and 7. The course consists of two units: "Computers in Society" (history of computers, present and future uses, computer related careers) and "Problem Solving with Computers" (programming in BASIC). By using a combination of hands-on computer activities and paper and pencil activities, the project allows as many as 10 students to work with a single computer.

Utilizing Computers in the Teaching of Secondary Mathematics
Focus: Mathematics
Contact: Jack DeTalvo, District Supervisor of Instruction, Asbury Park Board of Education, 1506 Park Ave., Asbury Park, N.J. 07712

Microcomputer-based instructional materials and techniques are used to improve the mathematics skills of students of all skill levels, grades 9-12. The program uses 30 computer-based teaching units which are integrated into the existing secondary math curriculum (Mathematics II, Algebra I and II, and Trigonometry). When students reach project topics in the normal course of study, they are assigned to a classroom equipped with microcomputers or terminals. The teacher provides an introduction of the topic. Then students are instructed to access specific computer programs.

READ: S
Focus: Reading
Contact: Walter L. Powers, Coeur d'Alene Public Schools, 311 No. 10th St., Coeur d'Alene, Idaho 83814

A comprehensive, microcomputer-assisted reading-in-the-content-areas curriculum, this

project uses teacher-developed instructional modules in the areas of vocabulary, comprehension, and study skills. Walter Powers, project director, explained the project's rationale: "Rather than attempting to convince math, science, social studies, and other content-area teachers that they must become teachers of reading, our project teaches them how to reinforce a hierarchy of 60 essential reading skills that are the foundation of the students' instruction in their language arts/English classes."

The project integrates five components: an instructional component emphasizing direct instruction in reading by language arts/English teachers; a reinforcement component, providing for mastery of priority reading skills in all content areas; an inservice component designed to help content area teachers understand, author, apply, and evaluate teaching/learning modules in their subject area; a management component for record keeping. An additional optional component is instruction on microcomputers to reinforce students' vocabulary, comprehension, and study skills. The project provides content-area teachers with authoring disks to enable them to create their own computer modules.

Other Demonstration Models

In early 1984, the U.S. Department of Education funded 12 technology demonstration models that address diverse curriculum areas. Each model is charged with providing a demonstration site and sharing information with other school districts. Here are brief descriptions of several of the models:

Science/problem solving. The Lynnfield (Mass.) Public Schools is developing a computer/video based curriculum unit to be used with Digital Equipment Corp.'s Interactive Video Information System. The purpose is to improve student learning in problem solving and physical science at the middle-school level. For more information: Douglas A. Russell, Lynnfield Public Schools, Main St., Lynnfield, Mass. 01940.

Writing: The NETWORK, Inc., will adapt for use in secondary schools commercially available software (Quill) initially developed to teach writing skills to elementary students by Bolt Beranek and Newman, Inc., Cambridge, Mass. Among Quill's software tools are a text editor called "Writer's Assistant"; a prewriting "Planner"; a "Library" for composing, storing, reading, and revision; and "Mailbag" for sending messages and exchanging information. In 1983-84, 10 school districts nationwide implemented Quill in grades 3-6. For more information on the secondary school adaptation of Quill, contact David A. Zacchei, The NETWORK, Inc., 290 S. Main St., Andover, Mass. 01810.

Computer literacy. The Houston (Tex.) Independent School District is developing computer modules, slide presentations, videocassettes, filmstrips, and printed materials correlated to its computer literacy program. The materials (for high school students) are focusing on higher-level thinking skills necessary for critical reading, creative writing, and problem solving in math and science, according to Robert Eicholz, project director. For more information, contact Eicholz, Instructional Development Coordinator, Houston Independent School District, 5300 San Felipe, Houston, Tex. 77056.

Compensatory education. An alternative model for compensatory education is being developed in Norwalk, Calif., under the direction of Stanley Pogrow of the University of Arizona. Students in grades 1-6 are spending one-half hour a day, 4 to 5 days a week, in a computer lab using commercially available simulation software. The goal of the project, according to Pogrow, is to imbed the learning of basics within challenging computer-

> **"We are now at a place where computers can revolutionize education. However, we also have a discontinuity. That is, we cannot continue to add computers, just for the sake of adding computers. We must restructure our schools, our curriculum, and our teacher training if we are to meet the challenge of the information society. And it is going to be very difficult for us to let go of what we have been doing. Education is at the stage of knowing what to do, but being afraid to do it. In order to accomplish this transformation, we will have to reevaluate our educational institutions and the mechanisms we use to finance them."**
>
> **— Andrew Molnar**
> **National Science Foundation**

based thinking activities. This should "not only increase performance in the basics, but should also provide the critical added benefit of improved analytical skills," he said. For more information, contact Pogrow, University of Arizona, College of Education, Tucson, Ariz. 85721.

Technology Tools

Ten of the "best new ideas" funded by the National Science Foundation (NSF) during 1978-80 to use computers and other technology for educational purposes are now available as commercial products.

These 10 new tools were produced by projects "which embody what scientists, mathematicians, and educators consider some of the best new ideas about what is possible," said Dorothy K. Deringer, formerly an NSF program officer, in announcing the names of the projects. The products should be of interest to educators, she added, because each went through extensive testing and formative evaluation.

They include software, books, a videodisc, and a process for organizing a community computer education program. All are described below except the videodisc (see the chapter on Other Technologies). Check with the sources listed for prices and hardware requirements.

The tools are: **MIT-Logo** — A machine language software program developed by Seymour Papert of MIT with $2 million in NSF funds. Deringer described Logo as a "powerful new idea for learning mathematics." Several software companies produce the program for various brands of computers.

Beware of These Problems

Districts may encounter many problems as they set up and refine their computer education programs. Here's a sampling, as revealed in interviews for this report with administrators in various school districts:

Turf problems. In one suburban district, the teachers in the secondary mathematics and science departments both claimed "the right" to teach certain computer courses (e.g., Pascal). An assistant superintendent noted: "We may have to resolve the problem by creating a Department of Computer Science."

Endangered species. As increasing numbers of students in one district elected computer courses instead of more traditional courses, teachers of art, music, home economics, and vocational education started to fear loss of their jobs.

Uneven activity. Teachers and principals in some buildings have seized the opportunity to obtain and use computers; others have weak or nonexistent programs because of lack of districtwide planning and little staff training, leadership, hardware, or know-how.

"A trendy thing." One district administrator worried that teaching with or about computers has become a "trendy thing." He added, "The teachers feel they should be doing it because of the talk and interest in it — not particularly because they think it is the best thing."

Leaping before looking. "Some districts are mandating computer education courses and starting a program without adequately preparing teachers and taking a good look at the curriculum," noted one administrator. "When this happens, both teachers and students stand the chance of 'getting burned,'" he added.

Different objectives. In one large surburban district, a computer curriculum committee recommended that computer use should begin in the elementary grades. The school board, however, voted to concentrate hardware in the higher grades, resulting in a frustrated committee and uneven acquisition of hardware in the elementary schools.

"Stardust without commitment." Some boards and administrators want to be seen as "with it" in offering computer courses. But their insufficient financial commitment for staff training, coordination, and follow-through limits the endeavor to a token gesture.

Computer Power — A new approach to teaching programming to interested students, grades 9-12, who are not mathematically inclined. Developed by J. Michael Moshell of the University of Tennessee, this software program teaches programming in the Pascal language through colorful animation. For more information: McGraw Hill, 1221 Ave. of the Americas, New York, N.Y. 10020; the program includes a one-semester text.

Graphing Equations — A software package developed by Sharon Dugdale of the University of Illinois. It is intended to help capable students, grades 5-12, build mathematical intuition by becoming fluent in understanding graphs. For more information: Conduit, M310, Oakdale Hall, University of Iowa, P.O. Box 3, Oakdale, Iowa 52319.

The WEPCO Electronic Blackboard Series: Algebra and Trigonometry — A software package of five diskettes for algebra, three for trigonometry, and a "functional plotter" which animates concepts for students who are not grasping them. The software was developed by Gerald Issacs, Richard O'Farrell, et al, of Carroll College, Waukesha, Wis. For more information: Wadsworth Electronic Publishing Co., 8 Davis Dr., Belmont, Calif. 94002.

Rocky's Boots — A software program that Deringer described as "electronic tinker toys." A game with the content of a logic course, Rocky's Boots appeals to both third graders (for whom it was designed) and graduate students. For more information: The Learning Company, 545 Middlefield Rd., Suite #170, Menlo Park, Calif. 94025.

My Students Use Computers: Learning Activities for Computer Literacy, a book by Beverly Hunter, tells schools how to infuse computer activities into the K-8 curriculum. They were designed with the help of experts and tried out in schools in Montgomery County, Md., and Alexandria, Va. Deringer advised schools to "look at this book if you want to teach procedural thinking to students." For more information: Reston Publishing Company, 11480 Sunset Hills Rd., Reston, Va. 22090.

Math Worlds: Exploring Mathematics with Computers — Software resulting from the work of Diane Resek and Jose E. Guitierrez of San Francisco State University. It aims at facilitating student programming through problem-solving games. For more information: Sterling Swift Publishing Co., 7901 South I-35, Austin, Tex. 78744.

Mathfun — Six software game packages which can be used by primary teachers who want to teach their students about complex ideas, including probability, estimation, problem solving, and other skills. Designed by William Kraus of Wittenberg University, Springfield, Ohio, these games are based on the list of basic skills developed by the National Council of School Supervisors of Mathematics. They show that second grade is not too early for students to be interested in probability, Deringer said. For more information: EduFun, a division of Milliken Publishing Co., 110 Research Blvd., St. Louis, Mo. 63132.

Computertown: Bring Computer Literacy to Your Community — a book by Ramon Zamora which describes a community computer literacy center. The book is available from Reston Publishing Company, 11480 Sunset Hills Rd., Reston, Va. 22090.

Technology Research Center

The federal government's major research facility for determining how technology can be used to improve science, math, and computer education in U.S. schools got under way with the awarding of a $7.6 million, five-year contract to Harvard University.

The university is working with a consortium of other organizations, including the Educational Testing Service, Children's Television Workshop, and the public school districts of Cambridge, Watertown, and Newton, Mass. The directors of the project are Judah L. Schwartz, MIT professor, and Gregory Jackson, professor of education at Harvard.

As the project got off the ground in early 1984, Schwartz announced these specific goals: to find ways for micros to help students understand particularly difficult concepts in math and science and to come up with recommendations on the development of specific software programs and on more effective ways of using television, voice recognition systems, videodiscs, and word processing with micros.

Chapter III

Planning

The AASA survey for this report asked administrators if their districts had an adopted board policy on computer education, a long-range plan for the use of computers, and formal guidelines to integrate instructional computing into the curriculum. The purpose of the survey was to obtain facts and opinions from a structured sampling of AASA members nationwide.

The results, as indicated by approximately 700 returns:

- 5 percent of the respondents said their board had adopted a policy on computer education.
- 20 percent said their district had a long-range plan for the use of computers.
- 10 percent said their district had adopted formal guidelines to integrate instructional computing into the curriculum.

Ninety-four percent of the respondents said students in their districts had access to microcomputers or computer terminals or both. But, until the advent of the microcomputer, many districts did not use computers in the instructional program. Consequently, districts have been slow to plan for their use.

"It would have been nice," one expert said in an interview for this report, "if schools could have been more systematic about this. But the reality is that the technology (usually microcomputers) started to move into the schools as districts found some money and some teachers and students got enthusiastic about using the machines. With this happening, it's been hard to be systematic."

Many districts are just starting to put together planning committees and to coordinate all of the disparate parts of their technology education effort. They're looking for help.

That help is starting to come — from state and regional agencies, "model programs," professional associations, computer users groups, business and industry, and community members.

At least one state legislature — Minnesota — has recognized the need for planning by requiring local districts to put together comprehensive plans for the use of technology as a condition for receiving extra funding.

Planning Models

Many different planning models are available. Most are limited to computers — specifically, microcomputers. Others encourage districts to at least think ahead to the day when their present systems will be inadequate for their needs or they will want to experiment with new or different forms of technology.

Each district has to decide on its own what it wants to do and then proceed. The advice of Lewis Carroll in *Alice's Adventure in Wonderland* applies. When Alice asked, "Would you tell me, please, which way I ought to go from here?" the cat replied, "That depends a good deal on where you want to get to."

Following are some different models, processes, and case studies from which districts may draw ideas for reaching their destinations.

First, an observation: Because of the way most districts got started with their technology programs (i.e., through "messing around"), they may have to modify the advice of planners, particularly with regard to the sequence of events. One example: Most planning experts advise districts to have a plan and determine specifically what they want to do *before* buying hardware. But the reverse has occurred in many districts. So, an important point to keep in mind is that planning

is a fluid process. Assess where you are now, and proceed in a logical fashion.

Massachusetts: Preplanning, Committees Stressed

"Preparation is everything (or nearly so) in implementing computer education in schools." That statement came from a technical report prepared by the Technology Lighthouse, a part of the Merrimack Education Center, a regional education cooperative in Chelmsford, Mass.

The Lighthouse identified the first stage of the planning process as preliminary planning. It includes these steps:

- Establish planning committees.
- Conduct staff awareness activities.
- Develop philosophy and policies.
- Document current computer activities.
- Identify resources.
- Conduct awareness for key groups.
- Establish priorities.

Planning committees. The Lighthouse recommends that districts form a K-12 systemwide committee which includes parents, teachers, administrators. The committee could be organized in several ways: by broad grade levels (elementary, junior high/middle, secondary); by subject matter areas; or by planning areas (e.g., curriculum, staff development, materials and equipment, organization, and implementation). The Lighthouse recommends the latter "because it fosters multidisciplinary involvement."

"We suggest a breakdown into subcommittees because there's a lot of work to be done," said Richard Lavin, the director of the Lighthouse, in an interview for this report.

The committee would function under the leadership of a district computer coordinator who, according to the Lighthouse's recommendation, would report to an assistant superintendent.

The Lighthouse also recommends that each subcommittee be made up of faculty and other resource people (e.g., consultants, community members, parents). The subcommittees would meet collectively only once or twice, while the individual subcommittees and coordinating committee would meet regularly to accomplish the actual work.

An advantage of this structure is that it allows involvement of many faculty members. Note, however, that it requires decision makers to give the committee clear direction on the tasks to be performed and good communication among coordinating committee members. The Lighthouse cautions districts that the work of the committee must be integrated in such a way that the results are directed to students on a K-12 systemwide basis.

The Lighthouse advocates the integration of computers and technology into the total curriculum; therefore, it advises that one of the major tasks for a districtwide committee will be that of developing or rethinking school system goals as they relate to K-12 computer applications and their integration into the curriculum. "As the school system gains expertise in the application of technology, the role of committees will increase in value, especially as it relates to the area of curriculum integration."

New York: Five-Stage Process

The New York State Education Department's Center for Learning Technologies describes the planning and implementation of a comprehensive computer education program as a five-stage process. The stages are: preliminary planning, curriculum planning, staff development, instructional materials and equipment acquisition, and organization and implementation.

These stages, the Center notes, may need to be repeated at regular intervals over a 5-10 year period because of rapidly occurring changes in technology.

The Center developed a checklist of all of the activities involved in each stage of the process (see the box in this chapter).

Minnesota: A Complete Process

New legislation passed in Minnesota in 1983 recognized the need for formal, comprehensive district planning for the use of technology (including, but not limited to microcomputers). Each district was given a minimum of $500 to use for planning, and the Minnesota Department of Education developed a planning guidebook to assist districts *(Planning for Education Technology;* Minnesota Educational Computing Corp., 3490 Lexington Ave., N., St. Paul, Minn. 55112; Order #611; $12).

The planning process described in the guidebook includes these steps:

1. Assessment or "Technology Status Check."

Planning Stages

STAGE 1: Preliminary Planning

- ☐ Establish planning committee(s).
- ☐ Conduct staff awareness activities.
- ☐ Develop educational philosophy and policy.
- ☐ Document current computer-based activities.
- ☐ Identify resources.
- ☐ Conduct awareness for key groups.
- ☐ Establish priorities.

STAGE 2: Curriculum Planning

- ☐ Develop broad goal statements.
- ☐ Develop student competency statements.
- ☐ Develop curriculum objectives.
- ☐ Develop instructional strategies and applications.

STAGE 3: Staff Development

- ☐ Identify required faculty computer competencies.
- ☐ Determine existing faculty computer competencies.
- ☐ Organize required computer competencies.
- ☐ Develop and provide training programs.
- ☐ Develop and provide other staff activities.
- ☐ Evaluate staff development activities.

STAGE 4: Materials/Equipment Acquisition

- ☐ Review curriculum objectives and instructional applications.
- ☐ Determine courseware needs.
- ☐ Determine hardware needs.
- ☐ Prepare procurement specifications.

STAGE 5: Organization and Implementation

- ☐ Appoint program coordinator.
- ☐ Establish logistical support.
- ☐ Establish materials and equipment support.
- ☐ Establish implementation support system.

Source: *Getting Started: Planning and Implementing Computer Instruction in Schools;* Center for Learning Technologies, New York State Education Department.

2. Philosophy.
3. Goals.
4. Implementation Plan.
5. Evaluation.
6. Review and Revision.

Step #1: Assessment

Districts should conduct an assessment primarily to answer the question, "Where are we?"

The Minnesota guidebook advises, moreover, that an assessment of technology is no different from an assessment of any other type of curriculum material or program. "Sound practices which have been successful in the past should be continued with this activity."

The following list of questions, taken from the guidebook, should help districts carry out their assessment:

- What educational technologies are currently being used (e.g., computers, telecommunications, television, film, cable, TV, interactive video, low-power television, satellite communications, microwave communications)?
- How much educational technology hardware do you currently have available?
- Where is the educational technology hardware located (e.g., in labs, regular classrooms)?
- What are the present applications of technology in each of the following: instruction, administration, classroom management, other?
- What skills do the staff have with the technology present in the district?
- What staff development opportunities are available?
- Is there a curriculum guide with an appropriate scope and sequence in the major subject areas?
- Is there a curriculum guide with an appropriate scope and sequence for the use of the various technologies?
- Is there a written plan with guidelines for implementation of technology?
- Are there advisory committees that are community-based as well as staff-based to provide an overall support network for technology?
- Is there one individual responsible for implementation of the overall technology program in the district?
- Are hardware purchases, software purchases, and equipment repair centralized?
- Are other educational agencies, organiza-

tions, or businesses involved in your technology programs? (If so, describe their involvement.)

Step #2: Philosophy

The second step in planning, according to the Minnesota guidebook, is the development of a statement of philosophy. Such a statement should explain the motivation that led the district into involvement with technology, describe the assumptions and beliefs upon which the plan is built, and suggest the general results that the plan is designed to produce.

The philosophy statement is necessary, the guidebook explains, to provide direction and focus to district efforts, to communicate current thinking of district decision makers to all constituents, and to develop a broad base of support among staff and community.

Sample statement of philosophy. A microcomputer committee in the 282-student Boonton Township (N.J.) Public Schools offered this rationale for including computers in the elementary curriculum:

The study of computers is a relevant and appropriate topic for the elementary curriculum because of the numerous applications computers have and will have in society. Children will learn to use computers in a masterful way, and, in learning to use computers, can shape the way they learn everything else. In using the computer as a problem-solving tool, children embark on an exploration about how they themselves think. Developing an understanding and appreciation for the workings of a computer and how to benefit from its use are ever increasing needs in a society today and in the future.

Our approach should be to expand the existing curriculum to reflect the role that computers best play in problem solving. This means we should decrease the emphasis upon the routine and rote methods of carrying out a plan to solve a problem and increase our emphasis on analytical thinking techniques: logic, thinking, interpreting symbolic language, and applying results.

The microcomputer is a tool that will be as commonplace as a slide rule was two decades ago and as pocket calculators and pencils are today. It is essential that it becomes an integral part of current education.

Step #3: Goals

In this part of the planning process, the district defines its plan in broad, general terms in order to provide guidance and general direction to those who implement the plan. The Minnesota guidebook suggests that districts also develop objectives and activities to define more precisely how each goal will be met. Here is an example:

Suppose that one of the district goals is to teach students about the impact of technology on society. The goal might be stated this way:

Students will describe how the increased speed of transportation and communication since the 18th century have changed the nature of the U.S. political system.

The corresponding objective might be stated this way:

Students can describe how global electronic communications have impacted on U.S. politics over the past two decades.

A sample activity to achieve the objective could be the following:

Students will view a film on electronic communications.

Step #4: Implementation

At this point in the planning process, the planners must move from ideal considerations to realistic expectations in light of these factors: personnel, equipment purchases and deployment, materials selection and acquisition, staff development, budget, and timelines.

In general, the Minnesota guidebook advises, the most important aspect of this phase of the plan is a realistic assessment of available resources. Most plans, it added, will call for change to occur over a period of time. Therefore, while district planners should think ahead a few years in constructing a plan, at the same time they should realize the need for flexibility as changes occur.

Step #5: Evaluation

A key step in the total plan is the periodic measurement of progress in meeting established goals. The Minnesota guidebook sugggests three areas for evaluation: progress on the implementation of the plan, changes in staff use of new technology and curricular adaptation, and learner outcomes.

Step #6: Review and Revision

The information resulting from the evaluation could be used to revise the plan. Because of the rapid changes occurring in technology, some ex-

Implementation Plan: 'Catch 22' for Districts?

The idea of having a full computer implementation plan in advance of introducing computers "might very well be a Catch 22," according to Sheila Cory, coordinator of staff development program evaluation for the Chapel Hill-Carrboro City Schools, Chapel Hill, N.C.

Writing in *The Computing Teacher* (November 1983), Cory explained: "It is impossible for a school system to know what to do with computers until its own faculty and staff know what computers can do, and it is not possible for them to know what the potential really is until they've purchased enough hardware, used enough software, and spent enough time learning to understand what the possibilities really are."

Cory described four stages that school districts experience before they can fully utilize computers:

Stage 1 — Getting on the Bandwagon.
Stage 2 — Confusion.
Stage 3 — Pulling It All Together.
Stage 4 — Full Implementation.

At each stage, Cory said, a district exhibits different characteristics with regard to hardware, software, staff development, computer-assisted learning, computer literacy, and attitude. To illustrate, here are some of the common characteristics of districts at stages 1 and 4:

	Characteristics	
	Stage 1	**Stage 4**
Hardware	Emphasis is on quantity, not quality.	Purchase of least expensive, simplest machine to do a given task.
Software	Little software acquired; usually teacher written or public domain.	Purchase based on plan; software libraries exist.
Staff Development	Considered unimportant; almost nonexistent.	Tied to district plans; participation required.
Computer-assisted learning	Any/all software used at all grade levels.	Software use based on research findings/ ongoing evaluation.
Computer literacy	Undifferentiated from computer-assisted learning.	Clearly defined; taught throughout all grades in sequential fashion.
Attitude	Ambivalence; "computers are transient in education."	Respect for capabilities and limitations of the computer; appreciation of computer as a tool of great value to all.

Note: See the magazine for a complete listing of all characteristics at all four stages.

perts advise that review and revision must take place at least on an annual basis — perhaps every six months. Revision will also be necessary as district staff become better trained and as more equipment and software are acquired.

Getting Help

For many school districts now using technology, planning requires some backtracking. Here's a typical case: District "A" already has some hardware and software, some inservice training in "computer literacy" has been offered, and some teachers have sought advanced training on their own. The district is fortunate to have a "technology buff" among its staff members. A computer literacy program is under way; parent interest is aroused; and demands are coming in for more equipment.

Clearly, planning is called for. Where can the district get help?

Among the available options: Do-it-yourself by reading, visiting model programs, asking lots of questions; seeking assistance from other districts; hiring an outside consultant to come in and work with the staff; sending someone to workshops and conferences; or turning to a service agency that specializes in planning.

An example of the latter option is the Technology Lighthouse located at the Merrimack Education Center, Chelmsford, Mass. It is one of 10 technology resource and information centers funded by the federal National Diffusion Network. (The other lighthouses are located in Alma,

Planning Tips for Administrators

These tips from various sources should help administrators in planning for the use of technology:

- ✔ Build a wide base for decision making about the use of technology. Students, parents, teachers (in all areas, not just in math and science), and building administrators all are good candidates for advisory committees to consider issues and make recommendations.
- ✔ Hire a coordinator of computer (or technology) applications.
- ✔ Don't expect or require an outside consultant to make decisions that should be made within the district.
- ✔ Consider planning as an evolutionary process that proceeds in phases. Here's the usual order: tooling up with hardware, software, and early computer training at all levels; planning as it relates to goals; and integrating computers into the curriculum.
- ✔ Plan instructional applications rather than technological applications. "Begin by identifying a need, realizing that technology may or may not be the solution," advised Ed Obie of the Alaska Department of Education.
- ✔ Plan to tailor the program to the school it is to serve, in terms of the goals to be met, the school enrollment, the budgetary restrictions, and the commitment and participation of the staff.
- ✔ Relate the planning effort to significant concerns for long-term improvement in both teaching and learning, rather than to short-term improvements.
- ✔ Prepare to work with a plan through four stages: initiation, support, implementation, and revision.
- ✔ Provide adequate resources for planning. Avoid frustration by allowing for adequate time, materials, space, expertise, and money.
- ✔ Expect over time to increase budget allotments for inservice education, teacher support (materials and personnel), software, maintenance.
- ✔ Look at "model programs." Remember that in most cases, you will have to adapt them to your district.
- ✔ Maintain the technology committee as an on-going, working group.
- ✔ Consider how you will involve parents and the community in the technology program.
- ✔ Be mindful of the many administrative policies that affect access to computers.

Ark.; San Francisco; Sarasota, Fla.; Couer d'Alene, Idaho; Oxford, Mass.; Hopkins, Minn.; Asbury Park, N.J.; Central Square, N.Y.; and Vancouver, Wash. For more information, contact Lee Wickline, Director, National Diffusion Network, Brown Building, Room 613, 400 Maryland Ave., S.W., Washington, D.C. 20202.)

The Merrimack Lighthouse conducts "Computer Applications Planning Seminars" (CAPS) for 12 districts at a time at its Massachusetts headquarters. In addition, noted Richard Lavin, executive director of the Center, the Lighthouse is starting to train "facilitators" who will use the Lighthouse model to offer planning assistance to districts in other areas of the country.

Here's how the CAPS seminars work: Each participating district is requested to enroll two persons in a seminar, preferably someone from the central office curriculum staff, and, if possible, someone who is knowledgeable about computers. They attend a one-half day orientation meeting and four full-day meetings over a period of four months. The topics covered include: preliminary planning for technological change, integrating computers into the curriculum, staff development, hardware and software acquisition, and organization and implementation. (The tuition cost for two persons to attend the seminar is $975.)

Each time team members attend one of the sessions, they are given assignments to complete upon return to their own districts. For example, they may be asked to conduct inventories of the hardware in use in their districts and of the training already acquired by staff members. The ultimate goal of each team is to prepare a plan for the use of technology in their own district.

When the proposed plans are submitted, three Lighthouse staff members read and evaluate them using a set of criteria developed by the Lighthouse. Each district receives recommendations for improving its plan, which can be used to prepare a "final" plan for presentation to the board of education.

Is it feasible to expect districts to prepare a plan in four months? Lavin said "yes" in an interview for this report. The plans will vary in quality, he noted, and some will turn out to be "first drafts" which the districts will redo, with guidance from Lighthouse staff.

In which areas do districts need the most help? "In matching the technology to the curriculum," Lavin said. "We try to teach people to understand and delineate the curriculum so it can be integrated with the technology. People also need some capability to begin to field test a pilot within their district, so they can innovate by using technology in the curriculum." He cited two examples: using word processing in teaching writing skills and using technology in teaching problem solving.

In addition to providing planning help, the Lighthouse offers assistance in the selection of hardware and training in the evaluation of education software, basic literacy, Logo, and classroom applications.

For more information, contact Richard Lavin, executive director, or see the Center's excellent publication: *Computer Applications Planning* (Merrimack Education Center, 101 Mill Rd., Chelmsford, Mass. 01824; $9.75).

Considerations; Impediments

In answer to the survey for this report, respondents gave their opinions about the "most important considerations in efforts to improve or expand the use of computers for instructional purposes" and the "major impediments" to doing so.

Here are the views of four survey respondents:

Respondent #1: Wayne R. Warren, Coordinator, ITV and Computer Media, St. James-Assiniboia School Division #2, Winnipeg, Manitoba, Canada:

Most important considerations: Decide firmly on one or two brands of equipment and stick with them, especially if they are universally supported; spend much time and money obtaining good professional software; establish micro-communications links to other users and sources; hire a coordinator you trust and authorize him or her to direct computer development. Do not let too many outside influences fragment a logical plan.

Major impediments: Lack of money is not the most serious impediment. Fragmented decision making is. A coordinator with authority to direct computer developments is very important . . . to make certain that poor decisions are not made. (He cited this example of the latter: purchasing hardware at a reduced rate from a manufacturer who then makes the equipment obsolete.)

Respondent #2: Daniel F. Chase Jr., Supervisor of Instructional Data Systems, Prince George's County Public Schools, Upper Marlboro, Md.

Most important considerations: Inservicing of classroom teachers; inservicing of supervisory

staff; orientation and updating of upper administrative personnel and board members.

Major impediments: Lack of sufficient inservice training and orientation of classroom teachers and supervisory staff; lack of proper and adequate resources for the program; lack of support from upper administrative personnel and board members.

Respondent #3: John J. Keough, Superintendent, Vestal (N.Y.) Central School District:

Most important considerations: A good plan; knowledgeable and skilled leadership; inservice training.

Major impediments: Growing like topsy — people getting on a bandwagon without sufficient knowledge and planning; lack of curriculum articulation.

Respondent #4: Kenneth Hoffman, Supervisor of Instructional Media, Upper Darby (Pa.) School District:

Most important considerations: Having a districtwide plan for the use of microcomputers; appointing one person to coordinate all aspects of microcomputer use; and developing a timeline for the implementation of microcomputers.

Major impediments: Time — because of the expense, it takes a great deal of time for schools to acquire microcomputers, to train staff, and to explore the range of microcomputer possibilities.

Case Study: Fairfield, Conn.

A 23-member committee spent eight months helping the 7,500-student Fairfield, Conn., Public Schools put together its K-12 computer education program in mid-1982.

"At the time, we were using computers at the senior high level, but we were doing almost nothing with them in the elementary and junior high schools," said Edward H. Bourque, assistant superintendent, in an interview for this report.

"The committee gave us some direction and set the tone for our approach," he added.

Dubbed the Computer Literacy Committee, it included teachers from all school levels, parents, and representatives from the business community. The chairperson was a district resident, parent, and manager of training and software for a large company. "We are very fortunate to have this woman living in our community who could help us with our program," Bourque noted.

In order to come up with a plan, committee members decided they had to answer questions such as:

- What should we be doing at the elementary, junior, and senior high schools?
- Over what time period should the program be implemented?
- What resources will be required as far as staff development, hardware, and support specialists are concerned?
- What resources are already in place in the district?

The committee undertook a number of activities to come up with answers. Here are some examples:

Assessment. The committee sought information in these areas: an inventory of both equipment and software in use in district schools; a listing of district classes using computers and of potential subjects which could benefit from computer support; articles on computer literacy, both pro and con.

Self-education. Committee members digested approximately 40 different reports, articles, and papers on computers in education.

School visits. Committee teams visited computer education programs in both Connecticut and New York to observe firsthand the effectiveness of the programs and to ask questions about the do's and don'ts of starting a program.

Putting the plan together. Following the completion of data-gathering, the committee divided itself into three subcommittees for the elementary, junior high, and senior high levels. Each subcommittee was given three weeks to draft a plan for its respective level.

Using the resulting plans, the chairperson then drafted the first version of the full district plan. It was presented to the entire committee, and put in final form for presentation to the Fairfield Board of Education.

The committee recommended a broad-based program which would emphasize the following areas: historical aspects and societal impact of the computer revolution; understanding how to communicate with a computer; using the computer as a direct instructional support system in remediation, enrichment, and programming.

The ultimate goal of the plan was to have computer labs in operation in all district schools within three to five years.

The committee also recommended a minimum of 10 hours of computer time per month per

student as the required standard throughout all district schools.

By early 1984, many of the committee's recommendations were being implemented. The district decided not to offer separate computer literacy courses, but to stress "computer awareness." As examples, Bourque noted that Computer Assisted Instruction was being used for supplementary purposes at all levels and that more than half of the high school students were using microcomputers in many classes, including math, English, languages, business, home economics, and science.

A district computer coordinator was appointed. Rather than make the job full time as suggested by the committee, the district had to settle for a half-time position. Each building also has a "school computer liaison" teacher. The Committee had suggested that this job be a nonpaying position. The district decided, however, to compensate the liaison teachers for their extra work (approximately $239 annually).

The computer coordinator and the liaison teachers make up a steering committee for the district's program; final responsibility for the program rests with Bourque.

The district has not yet reached its goal of having enough microcomputers to equip at least one computer laboratory in each of its schools, but that remains its goal.

The Computer Literacy Committee was disbanded but, Bourque noted, he still confers with the chairperson to update her on the district program and learn about new developments across the country.

Case Study: Lexington, Mass.

These uses of computers were envisioned in the long-range plan of the Lexington (Mass.) Public Schools, written in the fall of 1981:

A third grade student sitting at a computer station getting ready to load, run, and list a program.

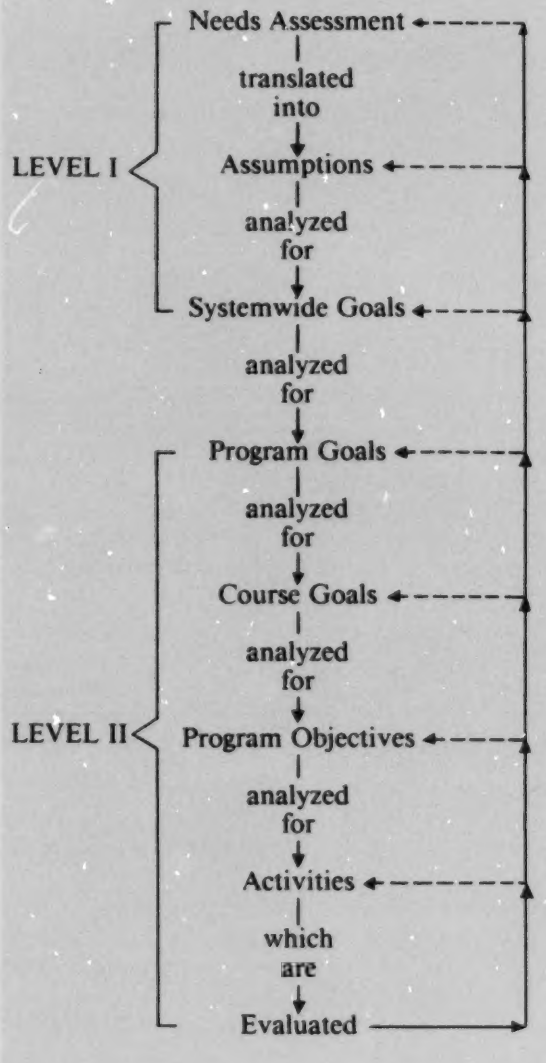
A junior high school student electing to take a follow-up computer course as a result of positive experiences in the required computer literacy program.

A student at the senior high level designing his/her own database management information system.

A teacher querying a terminal to determine the progress to date of two students.

A counselor using the computer to assist scheduling a new student.

Planning Model For Computers in Education Lexington (Mass.) Public Schools



An elementary principal using a terminal to examine how previous students have achieved in seventh grade relative to the level recommended by his school.

A program director querying a terminal to determine the exact cost to date of a program.

Now, those things are happening, and the district says its computer education program is "imitated by many, but equalled by few."

The main force behind the program is Frank DiGiammarino, an assistant superintendent who has a doctorate in educational technology.

DiGiammarino is adamant about the need for planning and staff involvement, but flexible and willing to experiment with instructional uses of computers. In an interview for this report, DiGiammarino explained Lexington's approach to planning and implementation.

People: A Key to Success

Lexington's practice of extensive involvement of people on planning and advisory committees is not a new one. It has long been served by a computer advisory committee consisting of staff and parents. In 1978, when the district bought its first microcomputers, the computer program was reorganized and the advisory body was formalized, ending up with two committees — representing the elementary and secondary schools. Certain members of each committee also served on a third advisory committee.

"In order to get the kinds of people I needed to help me with planning," DiGiammarino said, "I put together the Models Program." Staff members who had an idea for using computers (either microcomputers or the district's minicomputer) were offered district support and some financial resources. Each person talked over his or her idea with DiGiammarino, established an objective, and "sold it" to others in the school.

Some examples of the models: using text editing and word processing to teach writing and computer literacy, programming to develop problem-solving concepts, computer-enhanced language arts, computers in the science lab, computers in geometry instruction for low-level students, programming tasks for precalculus students, and Logo strategies.

While staff members were experimenting with different computer applications, they were also becoming computer literate. And, since there was a Model Program in almost every building, the district had a ready supply of experienced staff who could participate in planning and implementation.

Under DiGiammarino's direction, the advisory committees received initial inservice training to expose them to issues and applications they would need to consider in putting together a plan. "In the educational process," DiGiammarino said, "I tried to build on their ideas of what education should become, not what it was."

The role of such committees, he said, is one of "synthesis, evaluation, and feedback." It's not realistic, he said, to expect "the people in the trenches" to actually write a plan. Instead, Lexington's plan was written by a small corps of people, mainly DiGiammarino, an elementary coordinator, and a classroom teacher.

The plan took more than 18 months to develop. "In the beginning," Di Giammarino noted, "we thought we could do it much faster. But after we got into it, we realized it would take longer.

"But," he added, "it was well worth the effort. When you get 77 people to agree that this is a plan they will back, it's hard not to go along with them."

Planning Process

The district follows a two-level planning process. (See the illustration in this chapter.) DiGiammarino recommends this kind of detailed planning to any districts "that want computers to have a high payoff."

Here's how the process works:

Level I planning is carried out by a broad group of staff and is used to generate assumptions which can be analyzed to create systemwide goals.

Assumptions. Using Level I planning, Lexington developed seven assumptions to guide its program:

A. In order to understand the capabilities and limitations of computers, a developmental program of computer literacy should begin at kindergarten and proceed through the twelfth grade, including skills in the use of the computer as a tool and information about its impact on society.

B. In order to enhance the growth of problem-solving skills, students and teachers should use the computer as a tool and to manipulate words, numbers, and ideas in a variety of disciplines.

C. In order to improve the teaching/learning process, teachers and administrators should employ the computer's unique capabilities to interact at the student's own rate and cognitive level

and to track individual learning progress.

D. In order to expand students' intellectual curiosity, they should also be given an opportunity to use the computer for individual research and programming.

E. In order to assist staff in adapting to the use of computers, all teachers and administrators should be exposed to the basic elements of programming, machine operation, potential uses of computers, and effective classroom practices with computers.

F. In order to facilitate decision making, teachers and administrators should use the computer as a powerful means of storing, retrieving, and interrelating information.

G. In order to expand and enrich the program, teachers and administrators should endeavor to cooperate with and use human and material resources in the public and private sectors of the Lexington community and other communities.

Goals. The district related 14 goal statements to its assumptions to provide direction for the program. The goals are:

1. To control and program the computer to achieve personal, academic, and professional goals.

2. To use the computer to reinforce skills and knowledge by providing practice activities.

3. To use the computer to provide activities designed to lead the student toward the acquisition of new skills and/or knowledge.

4. To use word processors to focus attention on the development of revision skills to improve written expression.

5. To make ethical decisions about the growing economic, social, and psychological impact of

Equity — A Growing Concern

A question of increasing concern regarding the availability and use of computers in schools is the gap between the "have's and the have not's."

Advocacy groups are insisting that schools take responsibility for ensuring equity in computer use. Their concerns stem from reports such as the following:

- Data obtained by Henry Jay Becker, Johns Hopkins University, show significant differences in computer use by white and non-white low-income schools. He found significantly more instruction in computer programming in low-income, majority white elementary schools than in low-income schools where the majority of students were non-white. These schools were far more likely to use computers for drill and practice and to teach little or no computer programming. Becker attributed this finding to the fact that there are fewer "computerist" teachers in low-income schools with majority non-white students.
- Based on a survey of 2,500 districts, AASA concluded that federal Chapter 2 funds are helping districts move into the high technology area, but that the "block grant delivery system is creating a serious equity problem. Approximately 80 percent of America's students," AASA explained, "attend schools in 24 percent of the nation's school districts." But, it noted, the large urban centers are the big losers under the block grant program. "The small districts are gaining funds, but they serve fewer students." Fifty-six percent of the districts responding to the survey said they were using their Chapter 2 allocation for 1982-83 to buy books and materials; 50 percent said computer hardware; 34 percent, computer software; 25 percent, audiovisual equipment. Ninety-four percent of the districts said they were not funding the Emergency School Aid Act (one of 28 programs consolidated under Chapter 2).
- Irene Miura and Robert Hess of Stanford University found that computer "whiz kids" are rarely girls. In a survey of 87 middle and upper income students in grades 5-8, they found that 13 percent of the students — all boys — reported having home computers. One year later, in another poll of the original sample of students, home computer ownership had risen to 35 percent, with a 2 to 1 ratio of boys to girls. They also found a 2 to 1 ratio in favor of boys in enrollments in summer computer camps and classes.

What can schools do? The Project on

computers on individuals and society.

6. To understand the past, present, and probable future impact of computers on society.

7. To use computer-related hardware, software, and documentation to study the principles underlying their design, use, and maintenance.

8. To use information filed in networks of computer memories to do research.

9. To relate knowledge about computers to career goals and plans.

10. To use the computer to relate information about students' needs to curriculum objectives and to appropriate instructional materials in order to assist staff in making instructional decisions.

11. To use the computer to relate information about students, staff, materials, finances, and facilities in order to assist staff in making educational decisions.

12. To use computers to facilitate communication among buildings.

13. To offer a continuous inservice program to train staff to implement the district's goals for computer use.

14. To periodically explore new developments in educational uses of computers for incorporation into Lexington's plan.

Tying goals to assumptions. As the next step in its planning process, Lexington identified which of the 14 goals related to each assumption. It found, for example, that 5 goals (numbers 2, 3, 4, 8, and 14) related to Assumption B.

Defining the goals. To facilitate communications among the three different committees working on the long-range plan, Lexington next decided to clarify each goal, and, at the same time, to

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Equal Education Rights (PEER), an equity watchdog group, suggests 11 actions that local districts can take to open computer learning opportunities to all students. They are reproduced here with permission from *Microcomputers in the Classroom: Are Girls Getting an Even Break?* ($6.95; Project on Equal Education Rights, NOW Legal Defense and Education Fund, 1413 K Street, N.W., Washington, D.C. 20005).

1. Institute a computer literacy program as part of the core curriculum. Make one of the goals of the program to neutralize biased images. Encourage girls, minority boys, and disabled students to participate.

2. Make sure that any training for teachers includes a focus on strategies to encourage girls, minority boys, and disabled students to participate in computer instruction and related courses.

3. For any optional courses in computer instruction, make sure that course requirements are not unnecessarily difficult and they are clearly explained to students.

4. Review all software before purchasing to make sure it is non-biased.

5. Structure free time on the computer and after-school computer clubs so that all students are encouraged to participate, including girls, minority boys, and disabled students.

6. Offer evening programs about computers and their impact on jobs and education for parents and families. Include discussions of equity issues so that they can learn to encourage their daughters as well as their sons to study computer science.

7. Familiarize key teachers and counselors with the impact of computers on the job market so they can talk intelligently with students about job options.

8. Develop partnerships with local businesses both to strengthen the computer-based education program and to develop a concrete understanding of local employment opportunities generated by the computer and related technology.

9. Develop recruiting strategies that encourage girls, minority boys, and disabled students to enroll in any advanced, optional courses.

10. Develop a planning committee to manage the process of designing and implementing a computer-based learning program. Infuse equity into all of the goals and objectives of this committee's work. Ask parents and community groups to participate.

11. Make sure that computers are distributed equitably across schools within the district.

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identify the steps already taken to achieve it within the existing curriculum. Here is an example taken from the plan:

Goal: To use the computer to relate information about students, staff, materials, finances, and facilities in order to assist staff in making educational decisions.

Target Groups: Administrators and teachers.

Explanation: It is possible to store in the computer useful information about students, staff, materials, finances, and facilities. It is also possible to have the computer interrelate the above components to produce information which could be used in the management/decision-making process. Principals and teachers could request materials and/or equipment inventories, lists of students functioning above or below prescribed levels, comparisons of students' test scores with actual grades received, lists of students by learning style, by level of cognitive development, by instructional reading level, etc.

Implications: Space has been allocated [in the district minicomputer] to store the additional information needed to make effective managerial decisions. Administrators and teachers should address the issue of what is needed to make the computer system more responsive. An inservice course is being piloted with selected staff on how to retrieve the stored information. It does not require a knowledge of programming.

Steps already taken: Budgeting, accounting, personnel, and student records are constantly being evaluated for deletions and additions. Work has begun on developing models related to materials retrieval, tracking skill performance, and creating classroom subgroups.

Setting Priorities: "It would be impractical," the Lexington plan states, "to attempt to have all programs move ahead simultaneously and plan for immediate uses of computers in their respective areas. The human and financial resources to accomplish this just do not exist." Instead, the district decided to designate as priorities for the years 1982-1985 the following areas: math, K-12; language arts/English, K-12; reading, K-12; science, 7-12; business, 7-12; industrial arts, 7-12; instructional materials, K-12; and computer literacy, K-12.

With the setting of priorities, Level II planning got under way. It relates to specific programs. Under the direction of a program manager, a subcommittee relates systemwide goals to a specific program. The subcommittee writes *program goals* for the use of computers (which reflect the systemwide assumptions and goals). Then it writes *course goals* from the program goals and *program objectives* from the course goals. It prepares *action plans* which detail milestones to be achieved in meeting the objectives, and it *evaluates* the program activities.

Current Focus

Lexington's computer education program is evolving — and will continue to do so — as it is implemented in phases and evaluated for effectiveness. DiGiammarino noted: "As we said in our plan, first we are implementing information science (we initially called it computer literacy) as well as management of curriculum materials and of student data. After we got those in place, we said we would come back in with an organization to deal with computers in instruction. We are not deviating too much from our plan."

Successful implementation, in Lexington's view, requires attention to five areas: computer literacy (or information science), staff training, using computers as an instructional tool, hardware, and financing. Here is what the district has done in each of those areas:

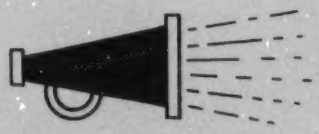
Information science. A group of 35 persons helped define the district's K-12 computer curriculum. It is broken down by grade levels (K-3, 4-6, 7-9, and 10-12) and by "applications," "hardware," "skills in using equipment," and "programming" requirements.

Here are some examples of how the curriculum is being implemented:

Students below grade 5 are exposed to nonprogramming computer literacy activities. All fifth graders take Logo I for one hour per week for 30 weeks; in the sixth grade, they continue with Logo II for one hour per week for the full year.

Seventh graders must take a computer literacy course for 1.8 hours per week for 16 weeks. They have the option of taking an elective in programming for 1.8 hours per week for 16 weeks. Students are also offered electives in grades 8 and 9.

In grades 10-12, students may elect to take either semester or full-year computer courses. Five electives are offered: Computers in Society (a hands-on course which introduces students to use of the computer for many purposes: art, music, math, measurement, writing); Data Analysis and Problem Solving (exploration of problem solving strategies in many areas); Programming (BASIC); Introduction to Pascal; Honors Computer Science (Advanced Placement).



Keep the Public Informed

"Do not overlook the importance of informing the community about your computer education program," cautioned the Montana Task Force on Computer Education in *The Elements of Computer Education: A Complete Program* (Office of Public Instruction, State Capitol, Helena, Mont. 59620; $7.50).

"As with any new program," the task force noted, "parents and community members should be educated. They can be valuable allies when new equipment is needed and the school district does not have available funds."

The task force offered these suggestions for disseminating information about a computer education program:

- Once your program is under way, print an introductory news release about it.
- Have a computer "open house" to demonstrate the equipment and explain how it will be used.
- Publish a monthly newsletter with ongoing information about the program, new software and peripherals, student and teacher reactions, and so on.
- Seek qualified volunteers to work with students on the computers. (You might seek them through the newsletter.)
- Find out if there are business people in the community who would be willing to let students come in to see their computers or who would come to your school as resource persons.
- Consider offering adult education classes in programming or computer use.
- Keep people informed about your program as it changes and grows.

Throughout the system, students at various grade levels are using computers for text editing and reinforcement of skills and in specific subjects (e.g., history, business, math, science, special education, home economics).

To implement the new curriculum, the district established a new Information Science Department. Following a recommendation of the planning committee, the leadership of the department is separate from that of the math department. DiGiammarino explained: "When you choose leaders from the math department, you tend to say to everyone else that you have to be math oriented to get involved here."

Staff training. Inservice takes many different forms in Lexington, including inservice at the district and building levels, by groups of teachers who request specific training to meet classroom needs, and "hand holding" of individuals. In implementing its plan, the district initially trained at least two persons in each building. Summer workshops enable teachers to develop materials used in computer courses.

Training is also provided to the librarian in each building. He or she is responsible for running the building's computer "learning center." The librarian's role will evolve from an "organizer of information" in the center to part-time computer teacher as well as communicator between the center and classroom teachers.

The district grants four or five sabbaticals each year, "and, invariably, three to four of them are in computers," DiGiammarino said. "They come back, and they are here helping us."

The district provided a management seminar and a two-week Logo training session for building principals. Each building now has the capacity through a hookup to a central computer for word processing and database searching. The district plans to teach those skills to principals.

Using the computer as an instructional tool. "We are beginning to move into the whole area of using computers as a tool in instruction, but we are deliberately moving slowly," DiGiammarino said. Among the problems he sees in this area is finding the software needed to do the job.

Two committees were formed to guide this phase of the district program: a steering committee and an academic computer planning committee that reports to the steering committee.

The steering committee's responsibilities include: updating the long range planning goals annually, overseeing progress in the schools, and

serving as liaison with other agencies and committees.

The responsibilities of the Academic Planning Committee, on the other hand, include: reviewing and recommending software, determining hardware requirements and recommending what needs to be procured, suggesting how teachers can appropriately integrate the computer into their teaching and how they can build on their students' previous computer knowledge, and suggesting inservice programs.

Financing and hardware. The district uses a combination of terminals (connected to its own minicomputer) and microcomputers. The district has a new computer learning center in each of its junior high schools and three learning centers in the high school. To help pay for the hardware that the district needs, a citizens committee conducted a year-long fund raising drive. (High tech industries alone contributed $40,000.) The district asked for a 50 percent discount on purchases from the Digital Equipment Corp. (the manufacturer of the minicomputer used by the district). DEC responded with a 35 percent contribution and also made a gift to the district of five terminals. The district also has found some ways to reduce costs. For example, it arranged to obtain an institutional loop of a new community cable system to upload and download software from the central computer to microcomputers and terminals in each building, thus saving phone line costs. The district has someone in each building trained in preventative maintenance of computers.

The Future

DiGiammarino said the district expects to implement a schedule that calls for each student to spend a certain number of hours a week in "computerland."

"We are going to get that time — a little from here, a little from there." Eventually, he added, the district will take a harder look at the curriculum and determine where it is teaching things like critical thinking and analytical skills. The idea is to teach these skills with the computer using the same amount of time that is available under the traditional curriculum.

For more information: Frank DiGiammarino, 1557 Massachusetts Ave., Lexington, Mass. 02173.

Chapter IV

Hardware, Time, and Money

In developing a plan to incorporate technology, specifically microcomputers, into instruction, school districts must take into account many factors. Of prime concern, for example, are hardware, time, and money.

Tips on each of these factors are included below:

Hardware

What kind and how much hardware should a district buy? Finding an answer is not easy, but more guidance is available now than when schools first started to purchase microcomputers.

David B. Thomas and Donald H. McClain of the University of Iowa advise that many new factors should influence school selection. Among them: advances in the technology, the large increase in the number of computers and peripherals available, the changes in school curricula brought about by increased availability of computers, dramatic price reductions, and the proliferation of software.

The explosive growth of the microcomputer industry and the constant changes within it cause some districts to hesitate when faced with purchase decisions.

"No one wants to buy obsolete equipment or software; yet, in view of today's volatile and rapid market growth, most of these items are somewhat if not completely obsolete the day that they are put on the market," notes the Technology Lighthouse of the Merrimack Education Center, Chelmsford, Mass.

It advises that fear of obsolescence should not prevent districts from making a purchase if they have determined that computers are an appropriate new technology for their instructional program.

"Don't over-spend or over-buy, but don't delay," the Lighthouse adds. "You will never learn how to utilize computers without accumulating experience with them. The skills learned on one machine should be easily and readily transferred to learning a second or third machine. . . . It is far more important to know *how* and *why* to use computers than to have the latest computer at any given time."

The Lighthouse advises that there are three types of computers that will be useful in the schools in the next several years:

- Low-cost portable microcomputers that can be dedicated to teaching about computers, limited Computer Assisted Instruction (CAI), and simple BASIC programming.

- Larger, on-desk type microcomputers that are now used in many classrooms to deliver CAI and CMI (Computer Managed Instruction).

- Higher speed, higher capacity minicomputer systems with central, hard disk storage that can deliver large-scale, comprehensive instructional activities for many students at once and that have enough capacity to handle all school information processes.

The latter point deserves special consideration by school districts. Some experts believe, in fact, that the minicomputer is the machine of the future for education needs.

Another tip comes from the Minnesota State Department of Education. As technology matures, it notes, "various products tend to look alike technically" (e.g., in terms of memory size, computational speed, number of keyboard keys). What might become more important, it advises, are the support aspects of the products (e.g., availability of software and textbooks to use with the product, availability of training, mainte-

nance, and the integrity and reliability of the sales company).

Decision-Making Process

Experts recommend that school districts follow a process in making decisions about the purchase of computers. One such process is described by David Thomas and Donald McClain in the *AEDS Journal* (Fall/Winter 1983; $10; Association for Educational Data Systems, 1201 Sixteenth St., N.W., Washington, D.C. 20036).

Thomas and McClain recommend that districts follow these steps:

1. Identify/describe the instructional situation. In other words, do a needs assessment of the intended uses of the computer (e.g., drill, programming, simulations, testing, information retrieval, word processing, laboratory control device).

Each activity has associated characteristics that can help define the features to look for in computers. Thomas and McClain note, for example, that color may be a necessary characteristic of the computer if it will be used for drill or tutorial purposes; it would not be necessary if the intent is to use the machine mainly for Computer Managed Instruction.

2. Infer computing requirements. This will require the talents of two persons — one representing instructional and the other computing expertise.

3. Check whether available computers and peripherals meet district needs; also, whether desired software packages are available for the machines in which you are interested.

4. Select computers to meet requirements. Consider all of the points above, plus these additional factors about each computer under consideration: flexibility and ease of use; availability of good documentation (instructions for use); expandability; manufacturer's reputation; dealer's reputation; service options; warranty.

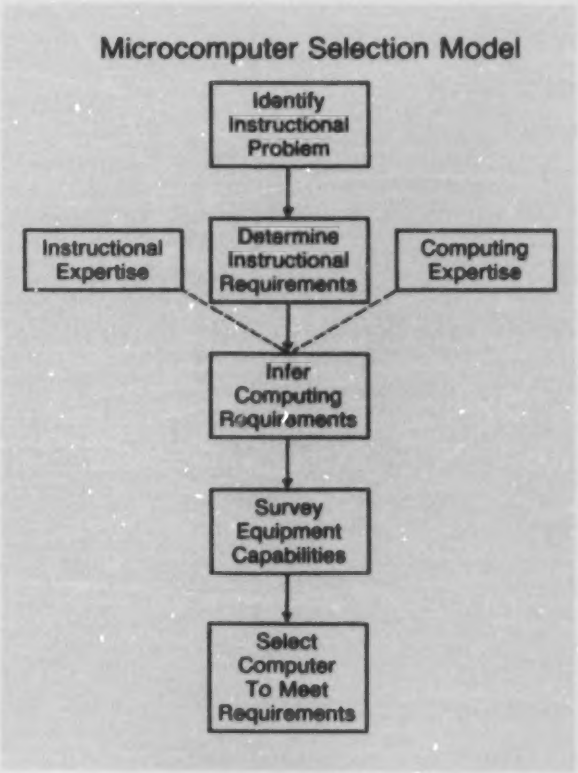
Another worthwhile idea is to seek information and opinions from many different sources — other school districts, computer users groups, regional service agency experts, dealers.

Ask these sources about the pluses and minuses of each model.

Ask about the appropriateness for your particular use of interesting features of different machines (e.g., networking, "mouse" control devices, built-in programs).

Listen carefully to the complaints. In interviews for this report, computer coordinators and administrators cited these kinds of cautions, based on their experiences:

- Don't buy cheap machines that won't hold up to heavy use. The result will be unanticipated expenses and too much "down time."
- Think in terms of both short- and long-term use. One district deliberately purchased a substantial number of cheap microcomputers in the first year of its long range plan because it wanted as many high school students as possible to gain some initial computer awareness. In the second year of the plan, the district planned to replace the machines with more expensive models, passing its initial purchases to the K-8 schools.



Source: "Applications of Microcomputers for Instruction and Educational Management," by David B. Thomas and Donald H. McClain; *AEDS Journal*, Fall/Winter 1983.

- Pay attention to "little" details, such as the keyboard. If a machine is to be used primarily for

word processing, a nonstandard keyboard is a poor choice.

- Have those who will use the machines "test-drive" the models you are interested in.
- Buy machines with enough memory to serve the purposes you will identify "later on."

A worksheet may help. Several state education agencies advise that the best method for evaluating how various brands of computers can meet identified needs is to compare them using a standard evaluation worksheet.

A worksheet prepared by the Montana Task Force on Computer Education, for example, recommends that decision makers rate hardware on 11 criteria. Included are: cost; service; user training; system expansion (e.g., will you be able to adapt it to future needs at a reasonable cost?); flexibility (e.g., can it be used for all the purposes you have in mind?); software; memory; keyboard; display; peripherals and options; and sound, music, voice, graphics. As each brand is tried out, it would be rated on each criterion, using a rating scale, for example, of 1 to 3 points.

To use this type of worksheet, you would also determine how *important* you consider each criterion (again using a rating scale of 1 to 3 points). To finish the process, you compare the total score resulting from the evaluation with the "importance" rating.

How many? As a general rule, districts can figure that an average of one machine per 10 students is equivalent to about one-half hour of machine time per student per day.

Some additional guidance comes from the Minnesota School Districts Data Processing Joint Board, St. Paul. It offers the following guidelines on the number of computers needed per student for various applications:

Application	Computers per	Students
Programming	1	2
Drill & Practice	1	1
Tutorial	1	1
Utility	1	1
Simulation/modeling	1	small group
Problem solving	1	small group
Information retrieval	1	dependent on application

Source: *Computer Literacy Curriculum Guide, Grades K-9;* Minnesota School Districts Data Processing Joint Board; September 1982. Reproduced with permission.

Maintenance

Stories abound about school districts and other organizations that have "gotten a good deal" on computers — that is, until they break down. Then, the purchaser finds out that the machines must be shipped a thousand miles or across an ocean to be repaired.

The stories dramatize the fact that computer maintenance can be a sticky problem.

No wonder, then, that some experts advise districts to pay as much attention to maintenance as to other considerations when making a purchase.

One list of questions to help schools find the best answer to the maintenance problem comes from Michigan's Tri-County Computer Consortium (representing the Oakland Schools, the Macomb Intermediate School District, and the Wayne County Intermediate School District). The questions include the following:

- Is there going to be an in-house maintenance/service person?
- What type of service warranty comes with the computer? "Most are for 90 days from date of delivery. This means that a computer delivered in late June may be out of warranty before it is unpacked in September."
- What type of service contract is available after the initial 90 days? "If the machine is obtained from a local vendor, there will be a better chance of obtaining an extended service contract than with a mail-order house."
- Will the vendor come out to pick up a machine that is not working or do you have to deliver it? What is the extra cost for pick-up service?
- Does the manufacturer have an option to train school technicians so that the unit can be serviced within the system? Are potential computer technicians available within the district?

Preventative maintenance: A number of manuals are available to help prevent computer problems and, thereby, to reduce maintenance costs. A good idea is to make sure that each room or building housing computers has a list of preventative maintenance measures and trouble shooting techniques.

Here are some tips on preventative maintenance from Kerry L. Johnson, El Camino Real High School, Placentia, Calif.:

- Electrical power to a computer and accessories should be within operating voltage ranges, usually 110 to 120 volts AC. . . . The power

source should be free from short-term power changes.

- Static electricity built up in the body can be discharged into the computer, especially through the keyboard, and damage integrated circuit chips. Reduce this probability by having users ground themselves to the case before using the computer or by using static-free carpeting or static prevention sprays.
- The microcomputer and peripherals should be in a dust-free environment.
- Operating temperature should be kept within range; avoid excessive heat to the computer or other equipment.
- Do not operate any computer in conditions where the humidity and temperature combination starts condensing moisture in the equipment. Keep all liquids away from the computer.
- Be extremely careful in the movement or transportation of computer equipment.

District practices: For some districts, particularly those with a sizable number of machines, the answer to hardware problems is to hire or train a maintenance person or crew.

- In the Lexington (Mass.) Public Schools, for example, two staff members took a course in hardware maintenance at a local college. In the following year, the district offered a similar course to high school students. The idea was to give the students a vocational skill and also allow them to help repair school computers.

- The Jefferson County School District, Lakewood, Colo., hired two full-time persons to maintain and repair its 2,000 instructional microcomputers. The employees, both with backgrounds in the repair of electronic equipment, were trained at factory-sponsored technical schools.

The district's technicians work in conjunction with each school's building level consultant. The consultants are responsible for performing simple diagnostic checks to determine what the problem might be, but they are not responsible for repairing defective equipment. A consultant identifies the problem, contacts the maintenance department, and, if it cannot be easily resolved, a school route driver picks up the defective device and takes it to the central repair facility. It is returned to the school after the repair is made. The maintenance department budgets for all repairs, and individual schools are not charged for them.

In its microcomputer maintenance plan, the

Minis vs. Micros: Which Is the Best Buy?

Some districts are concentrating on obtaining enough microcomputers to meet instructional and administrative needs. The experts are advising, however, that they should investigate larger capacity machnes, e.g., minis, before confining their districts to micros.

Here are the highlights of an interview conducted in early 1984 by the editor of *SchoolTechNews* with Peter F. Stoll, manager, Interactive Technologies Program, New York State Department of Education, Albany:

Q. Why do you recommend that schools consider using the more expensive minicomputers (estimated cost: $50,000 to $100,000 per system) instead of stand-alone micros?

A. Because they do so much more. Using one mini in a networking system, a principal can conduct administrative work more effectively, including the ability to plug into the system from home at night; teachers can perform both administrative and instructional functions at the same time, making their work much more effective; and students can work on more individualized instructional materials at school or at home. Teachers can save precious class time by not having to check each separate micro in a class or lab and by using an automated attendance system.

Q. Wouldn't the mini cost too much for a school?

A. Yes and no. Administrators should not let the higher cost of the mini mislead them. It's the cost per student that counts. If many students use a mini in a networking system, the cost could be less per student than with stand-alone micros.

Q. What's the best solution?

A. In many cases, the best answer for a school might be the use of a combination of micros and a mini, with the micros acting as both stand-alone machines and as terminals connected to a mini.

Tips on Buying Equipment

✔ No single brand of computer is best for all applications. Buying different brands of equipment to meet different needs (within the same district) might be a good idea.

✔ Generally, the useful life of equipment is three to seven years.

✔ In general, districts should first find the software they want to use before purchasing hardware (to assure compatibility). There are some exceptions. In the selection of word processing, the equipment may be selected first and the software second, since many of the available software packages have the same features.

✔ Placement of equipment should be based on instructional needs. For example, if a teacher will be using a videodisc unit to give a demonstration to a class, a single "floating" unit is appropriate.

✔ Districts should purchase as much equipment as is needed to cover any goal/objective that teachers are directed to work toward. If all of the equipment cannot be purchased, revise the goal/objective.

✔ Don't forget to budget for the extras: mobile carts or additional furniture for new equipment; changes in lighting, air conditioning, and electrical supply, if needed; maintenance costs.

district budgets for the salaries of the technicians, service manuals and diagrams, additional training, transportation, work benches and tools, and parts and inventory adequate to last two months. (The district determined that most parts were cheaper if bought from local electronic parts dealers than through direct factory purchase.)

Money

Don't underestimate the cost of making micros (or other technology) part of your instructional program. If the machines are to be more than window dressing, a lot of additional expenses should be anticipated.

With regard to funding, starting a program is not unlike getting married. Buying wedding clothes and rings is only the beginning. The major commitment of funds lies ahead.

How much does it cost to implement new technology into instruction?

There is no easy answer to that question. It depends on such factors as the types of technology to be used, for what purposes, across how many grades and courses, over what period of time, and affecting how many teachers and students.

Some districts, in putting together long-range plans, have attached "soft" projections to a "wish-list" of desirable equipment, software, training, and other costs.

Attaining what's on the wish-list, moreover, may depend on the district's ability to secure grants and donations in combination with general and/or capital reserve funds.

Sample Budget

Several experts have suggested that school districts budget 1-2 percent of their funds annually for instructional computing. In *The Computing Teacher* (March 1984), editor David Moursund proposes that a "good initial goal for a district to establish a solid program of instructional use of computers" would be an annual allocation of 2 percent.

Moursund also suggests five categories of expenditures and how the allocation might be divided:

Category	Suggested Percentage
Hardware	50%
Software, print materials, and other support materials	16%
Inservice education (initial and continuing training for administrators, teachers, support personnel, and aides)	8%
Computer coordinators	16%
Contingency*	8%

*In the first year, Moursund suggests, this amount might be used to supplement inservice education; in subsequent years, it might be used for purposes such as remodeling, accessing large data banks, videodisc or other special purpose peripherals, or setting up a hardware/software lending library for students and parents.

Funding Sources

In the first rush to get microcomputers into schools, districts depended on special funding sources, generally federal and state grants, according to Henry Jay Becker, Johns Hopkins University.

In fact, he said, about half of school microcomputers acquired through January 1983 were obtained with funds from special grant programs. Other important sources at the elementary level, according to Becker's sampling of more than 1,000 microcomputer-using schools, were fund raising activities and contributions from parent-teacher associations.

Here's Becker's breakdown of the sources of funding for school microcomputers:

Source	Average expenditures coming from this source	
	Elementary	*Secondary*
Grant funds	29%	34%
General school system	23%	30%
PTA and fund raising	19%	4%
Principal's funds	11%	11%
School dept. funds	10%	17%
Contributions (money and equipment)	8%	4%

Where else can you turn?

State contracts. Many schools have participated in mass-purchase contracts arranged by state education agencies.

Giveaways. Some schools have received hardware and software from large companies (e.g., IBM, Apple Computer, Inc.) as a result of special programs or "giveaways."

School/industry partnerships. Some schools and districts have formed partnerships with local companies. The Forest City (Iowa) School Board, for example, signed a contract to establish a "model education center" to demonstrate use of technology in the teaching process. Also signing the contract were Control Data, Waldorf College, and Winnebago Industries.

Foundation grants. A committee of NAVA, the International Communications Industries Association, identified 45 foundations out of 240 surveyed that make grants for classroom and library purchases of media and materials.

In *Foundation Funds for Education: Guide to Grants for Elementary, Secondary, and Post-Secondary Schools,* NAVA notes that "competition is keen for foundation funds." It adds that "the applicant who supplies all of the requested information and documentation and presents a concise, well organized, and strong project is most likely to get funded."

Another important factor in funding decisions is the location of the district. Many foundations restrict grants to their own state or geographic area or to communities in which they have plants or offices. (The guide is available from NAVA, 3150 Spring St., Fairfax, Va. 22031; $11.50.)

Other ideas. Kenneth Hoffman, supervisor of instructional media for the Upper Darby (Pa.) School District, offered these ideas:

- School district energy reduction grants. Using this strategy, a district would compute the average energy consumption cost for the prior two years for each building, and the result would be a base average. The school with the greatest annual percent reduction in energy consumption would receive money from the district to purchase microcomputers.

- School district vandalism reduction grants. The district would determine the average vandalism cost for each building for the prior two years, and make students and the community aware that each school was competing to reduce vandalism costs. Annually, the school with the greatest percent reduction in vandalism costs would receive money from the district to purchase microcomputers.

- Alumni grants. Schools could contact alumni and ask for tax-deductible donations to be used for curriculum improvements. Hoffman cautions that this funding approach would require considerable administrative time to implement and that the district would have to allow for some bulk mailing expenses.

- Community business grants. Local businesses, Hoffman noted, might make a tax deductible contribution or equipment donation to the district. Another idea: A local bank, insurance company, or other business might sponsor one or more microcomputers in a particular curricular

area, resource center, or library. If you are interested in this approach, start by making local businesses aware of school needs.

Cautions

How the funds are obtained. Some critics object to the way schools are funding the acquisition of hardware and software. They argue for a reallocation of district funds and/or raising the budget and using the new money for technology-related expenses. "Schools cannot continue to purchase computers without more money — unless they are willing to stop financing scores of other school programs," noted Lawrence Lipsitz, editor of *Educational Technology* magazine. In an article in *PTA Today*, he added: "The schools should not have to rely on the local PTAs for the funds needed to enter the era of computer-aided learning. The schools should not have to depend on this type of funding to meet basic educational objectives. The PTAs cannot be expected to provide funds year after year to buy computers and software — that is not their proper role."

Accepting donations. Sometimes, schools or districts might be better off turning down a donation of a computer or other equipment, according to some critics. Parent groups or others often donate hardware or other items, but the result in some districts has been chaos because each system requires different software and different skills to operate. And, in some cases, schools are stuck with large maintenance contracts, or they receive equipment that is hard to fit into the school program.

What can schools do? A policy adopted by the Fairfax County, Va., school board proved helpful, according to a report in *The Executive Educator*. The policy prohibits anyone from giving computers directly to a school. Instead, the donor is asked to give funds to the central office. It purchases hardware that is compatible with the needs of students and the school curriculum.

Some additional suggested guidelines on accepting donations come from Sandy Wagner of the Santa Clara (Calif.) County Office of Education. He advises districts to ask these questions of companies bearing gifts:

- What assistance will you provide to the school to ensure that it can make effective use of the computer and to train the staff?
- How much of our own teacher time will be required to produce an adequate computer-based instructional program with this equipment?
- How can these computers be used in our program now?
- What ongoing costs are we going to experience if we accept this gift?
- Who else is using this computer around here?
- Do we want to build our school or district computer program around this brand?

In other words, Wagner is suggesting that districts must confirm for themselves the answer to this question: Do we really want this gift?

Tips on Cutting the Cost

Respondents to the survey for this Critical Issues Report hold a variety of opinions about the funding of new technology for their schools. An example: When asked for tips on obtaining hardware and software at little or no cost, one New Jersey superintendent admonished: "I would hope we have matured beyond the state of looking for 'free lunches.'"

Other respondents, however, did offer these suggestions for low-cost acquisition or cost reduction of hardware and software:

- ✓ Contact utilities that may be upgrading their equipment.
- ✓ Ask for donations from business and industry.
- ✓ Participate in bulk or mass purchases (e.g., through local or regional consortiums, state education agencies, users groups).
- ✓ Take advantage, when appropriate, of "special offers" from manufacturers and distributors.
- ✓ Negotiate for free software/training when you purchase hardware.
- ✓ Consider lease/purchase arrangements for hardware.
- ✓ Build community support for additional funding or for refocusing current funds by working through parent groups, service groups, adult education.

Time

The Wisconsin Department of Public Instruction offered this advice on implementation of technology in the *1983-84 Wisconsin Guidelines*

for Instructional Computer Use in Education, K-12:

Implementation of technology must be a gradual process. Planning for the use of computers to help teach the curriculum must include some allowance for a phased implementation of the plan and some carefully considered time lines for teacher training . . .

Working with a selected group of people first, rather than with a total district, has many advantages. If a core group can be made to feel completely comfortable with the computer or other technology, they will serve as excellent role models for other teachers.

Limited budgets for the acquisition of hardware and software also speak to the need for gradual implementation. The degree of implementation will be determined by the number of computers available and the level of trained staff. Also, because technology will be constantly changing while this implementation process is going on, the plan must be flexible enough to adapt to necessary changes.

Many districts reflect the wisdom of those words by simply stamping "Draft" on technology planning and implementation documents.

Some other districts achieve the same effect by including a cautionary note in the introduction to their planning documents.

For example, the Scarsdale (N.Y.) Public Schools noted in its three-year plan for developing computer instruction that projections fell "somewhere between a wish-list and a detailed blueprint." The district explained:

The plans outlined here are open to change. We are learning a great deal every year and we may change our views of what is desirable and possible. The machinery is certainly changing rapidly. The plans listed here are dependent on budget decisions which cannot be predicted. So there are many "ifs" in any projection of this sort. With all of this uncertainty, however, we have found it helpful to look ahead. It helps us to be more thoughtful about where we are going and how we will get there.

Five-year plan. The Princeton (N.J.) Regional Schools outlined the three main goals of its five-year model (1982-87) for integrating computers into all grade levels, as follows:

- Extension of computer experiences through the elementary grades to the extent that the learning experience is supportive of the district's commitment to the teaching of thinking skills.
- Integration of computer experiences throughout the middle school and high school programs so that computer science is perceived as a basic skill fully applied rather than an isolated separate specialty.
- Adoption of computerized administrative techniques such as word processing and record keeping in order to streamline operations and demonstrate real applications of the technology.

As part of its plan, the district offered a chronology for implementing parts of the computer program at various grade levels.

In the chart below, for example, the district shows how it intends to extend elementary school applications of computers downward to its youngest students:

Chronology for Elementary School Program

Application	*'82-83*	*'83-84*	*'84-85*	*'85-86*	*'86-87*
Logo	gr 4-5	gr 3-5	gr 2-5	gr 1-5	gr K-5
Word processing		gr 5	gr 4-5	gr 3-5	gr 2-5
Simulations	gr 4-5	gr 3-5	gr 2-5	gr 1-5	gr K-5
Applications			gr 4-5	gr 3-5	gr 2-5
CAI		gr K-5	gr K-5	gr K-5	gr K-5
Classroom activities		gr 4-5	gr 3-5	gr 3-5	gr 3-5

At the middle school level, the district proposed to offer "Computer Literacy I and II" (programming), starting in 1982-83 and continuing through 1986-87. It proposed a "turn-key approach" to training staff members during the two-year period 1982-84. In addition, it proposed to develop projects making use of computers in conjunction with regular classes and to implement the projects, starting in 1984-85. If the district follows the plan, all students by the end of grade 8 will have substantial experience with programming and opportunities to apply computer skills in the academic program.

The district also noted in its plan that as elementary students begin to use computers, the middle school program would have to be adjusted to "the elevated level of skills [of these students] upon entry."

At the high school level, the district said it would strengthen and extend its course offerings

in computer science "while working toward integration of computer use with the regular school program." It noted, for example, that some departments had already moved to establish computer skills as an integral part of their programs (e.g., business subjects focused upon word processing), "and that others will be moving in that direction as inservice activities are provided to plan for the change." Here, too, the district planned to phase in the use of computers, starting with foreign language and social studies and moving to art, musical composition, and drafting.

Caution: Staggered implementation of a district technology plan is not uncommon. But, notes the Minnesota planning guidebook, priorities must be established. A district may decide, for example, that it must offer technology courses to those who are entering the marketplace or going on to technical fields in college. Or it may want to expose very young students to technology. If the existing curriculum is used to determine need, according to the guidebook, "then weak areas in the existing instructional program which can rapidly benefit from the use of technology will become the first targets for implementation."

The guidebook also cautions of inherent disadvantages of "gradual phasing in of changes." The most difficult: the building block nature of most objectives. The guidebook explains: "What is desirable to teach at the seventh grade cannot be taught because students have not developed the prerequisite skills at lower grade levels." The result is constant change as staff and students gradually build proficiency.

Another method of phasing in might involve using only part of the staff to pilot a new program. The disadvantages of this approach, according to the guidebook, are two: inconsistency from teacher to teacher and from year to year (as far as students are concerned) and exacerbation of existing problems of unequal access to technology.

The guidebook advises:
If not all goals can be addressed at once, priorities must be chosen with the inherent dangers in mind, so that precautions are taken to avoid creating long term problems. Most important is that the timelines be realistic. Nothing will do more to prevent the proper use of technology than an initial exposure that turns off staff and students because they are expected to achieve impossible goals.

Chapter V

People; Staff Development

While new forms of technology will fuel the technology revolution in every aspect of modern life, it is people who will determine whether the revolution catches on in schools.

What roles do school staff play? Who should take the lead? How about the supporting cast? Schools and districts are just starting to answer those questions. Following are some of the directions that experts are advising them to take.

Administrators

One way to help ensure the long-term success of a program using microcomputers or other technology is to have administrators who are knowledgeable about and supportive of the new technology. That is easy to say — and hard to do.

Some administrators interviewed for this report said the "technology revolution" in their district started several years ago with a single teacher and that they "still had not had the time nor taken the time" to get involved.

In some other districts, however, a member of the central office staff (often an assistant superintendent for curriculum or instruction) has been given responsibility for oversight, with day-to-day coordination handled by a full-time or part-time computer (or technology) coordinator. Another common practice is to appoint a contact in each school, often a teacher, to work in concert with the district coordinator and to coordinate building-level activities.

Principals

Some authorities have targeted the principal as the person who can make or break the technology program in his or her building. One example: *Planning for Educational Technology*, a guidebook released by the Minnesota State Department of Education, advises that principals should be trained — ahead of teachers — in the use of technology. Why? The guidebook says principals should be aware of technological influences on all curriculum areas; they should be aware of costs in hardware, software, inservice training, and personnel; they should be able to support and advise their staffs; and they should be able to answer questions about what is going on "technologically" in their buildings.

Should the principal be expected to manage the computer program in his or her school? No. "In most schools," according to David Moursund of the University of Oregon, "the school principal cannot be expected to fill the role of computer specialist. It's silliness to think that is going to happen."

However, it is "logical, but clever, administration," he said, for the principal to identify someone as early as possible to coordinate what is happening in the school.

Moursund's advice: "You want to put together either a committee or certainly one individual, identify the individual as the computer specialist, and do something to help that person out, such as arranging for training and release time."

How "literate" must administrators be about technology? Some experts advise that administrators — principals, for example — must become daily users of new educational technology.

"Only with the understanding that comes from this personal experience can they have some sense of comfort and good judgment about what other people should be doing with technology," advised Beverly Hunter, president of Targeted Learning Corp., Amissville, Va.

By using general purpose software such as spreadsheets, she said, a principal can get some

insight into how to use the tools and at the same time see their learning and teaching values.

Hunter also advocates that administrators use microcomputers for another reason. "Both the overt and covert curriculum in high schools must change," she said, "to engender the kind of environment that's needed to help students survive in a high tech society." These changes, she added, involve the creation of a new culture in the schools — one that encourages more student creativity, active learning, and students working in groups and communicating with each other.

"Bringing in the machines," she noted, "somehow turns people on to making the necessary reforms — with the help of leadership from the principal. The things that need to be done will start happening."

Competencies Identified

Ted Mims of Louisiana State University and Jim Poirot of North Texas State University identified what school administrators should know about educational applications of computers. They came up with a total of 42 competencies which were evaluated by a group of 10 authorities in the field of educational administration and computing and by a panel of 31 educators and computer vendors. The result: 38 of the competencies were judged of "at least medium importance" for school administrators.

The 10 competencies receiving the highest mean ratings follow:

1. Be able to justify the cost of educational computing.
2. Have a working knowledge of computer hardware and software terminology needed to communicate with data processing or computer professionals.
3. Be able to identify possible funding sources for instructional and administrative computing.
4. Be able to identify training needs of teachers in the use of the computer as an object of instruction, as an instructional medium, and as a problem-solving tool.
5. Be able to demonstrate an awareness of future trends in computing as they relate to educational computing.
6. Be able to describe the computer training needs of students.
7. Be able to identify training needs of teachers and administrators related to the administrative uses of computers.
8. Be able to identify various alternatives for using computers in instruction.
9. Be able to discuss legal, moral, and human impact issues of computing, particularly as they relate to educational uses.
10. Be able to identify administration tasks that could be computerized.

Note: The least desirable of the 42 competencies for administrators, according to the evaluation panel, is this: "Be able to write simple programs."

District Coordinator

"The key to establishing and providing for a school district's computing program is identification and selection of a capable computing leader. Without such a leader, a district's program will not succeed."

That advice came from Ken Brumbaugh and Don Rawitsch, executive director and director of user services, respectively, for the Minnesota Educational Computing Corp. (MECC).

Brumbaugh made the point even more emphatically at the 1983 annual meeting of MECC. When asked in an interview, "which should come first — a [district] plan or a coordinator?" Brumbaugh unhesitantly replied "a coordinator."

Having a coordinator is critical, he said, because full-time teachers and administrators cannot keep up with all the information they need to do a good job.

Responsibilities. Todd Hoover, assistant professor, Loyola University, Chicago, and Sandra Gould, program coordinator, Joliet (Ill.) Public Schools, said the job of the computer coordinator may include responsibilities in six different areas: planning (the most important role, in their opinion), fund raising, purchasing, maintenance, training and information distribution, and administration.

Qualifications: *Planning for Educational Technology*, a guidebook developed by the Minnesota State Department of Education, says the person selected as district coordinator should be a professional educator with excellent communications and human relations skills as well as background and experience in new technology, specifically in its instructional use.

David Moursund of the University of Oregon recommends that school districts appoint a computer coordinator "on the basis of someone who wants to do it and who has the qualifications." This person, he said, should have knowledge

Respondents Offer Tips for Staff Development

Respondents to the survey for this Critical Issues Report offered numerous tips for effective staff development programs on the use of technology. Here's a sampling:

"Must be hands on — two or three people to a computer. Teachers need opportunities to apply what they have learned after the inservice." — Corinne S. Berglund, Director of Support Services, Branford (Conn.) Public Schools

Use formal and informal means of helping staff gain knowledge and expertise in the use of computers; provide demonstrations ("when you have a free period, come see this new program"); simplify tasks or dazzle them ("Here's a crossword puzzle for the spelling words your students are doing this week . . . I used the computer to do it!"); let the computer do the training (tutorials). — Doris Ray, Library/Media Center Specialist, Dixfield, Maine

"Make sessions fairly long (5 hours) and concentrated (over a period of two or three days) in contrast to, say, one hour per week for six weeks. Relate most of your instruction to content interests and strengths/assignments of teachers." — Frank A. Anderson, Executive Director, Northern Colorado Educational Board of Cooperative Services, Longmont, Colo.

"Encourage teachers to keep student records on computers. Gets immediate interest." — James Tackmann, Superintendent, Cedar Springs (Mich.) Public Schools

"Work with small groups of teachers — two or three to a computer so all can have some hands-on time. Ten people and three computers is ideal for one trainer." — Robert E. Childs, Superintendent, Jackson County Schools, Marianna, Fla.

"Inservice should specifically meet your district's plan for the use of microcomputers." — Kenneth Hoffman, Supervisor of instructional Media, Upper Darby (Pa.) School District

equivalent to a bachelor's degree in the computer field. "That tends to be translated into a master's degree in computers in education," he noted in an interview for this report.

At the school level, he added, "the heads of the English department and the math department typically will minimally have the equivalent of a bachelor's degree in their field, and often a master's degree in it. It would be desirable," he noted, "if we could find a computer specialist in the school with that level of training, but that is out of the realm of possibility at this particular time.

"So," he concluded, "we find the person or persons who are most interested and who are acquiring the knowledge and we do what we can to facilitate them to continue to acquire more knowledge."

Returns to the survey for this report indicate that a wide variety of persons are given responsibility for district technology programs.

In New Holstein, Wis., a district with two schools and 1,678 students, the responsible person is a math teacher. Similarly, a math teacher is in charge of technology for the 2,800-student district in Fort Mill, S.C. The head of library/media services is in charge in Schoharie, N.Y. (two schools, 1,430 students); the director of the gifted/talented programs in the Lakota School District, West Chester, Ohio (eight schools, 6,670 students); the head of the science department in the Columbia School District, Brooklyn, Mich. (four schools, 1,997 students); the director of the Chapter 1 program in Peoria, Ill. (38 schools, 18,000 students); the media supervisor in the Warren County Schools, Warrenton, N.C. (nine schools, 3,300 students); and the band director in the Community Unit Schools, Erie, Ill. (four schools, 950 students).

Sample Job Description

This job description for a coordinator comes from the Jefferson County School District R-1, Lakewood, Colo.:

Title: Resource Specialist, Instructional Technology
Department: Library Media Services and Instructional Technology
Responsible to: Executive Director
Salary: Salary schedule as per board policy
Work Year: 205 work days

Qualifications:
- Valid Colorado teaching certificate.
- Extensive course work and experience in instructional technology/instructional media design.
- Knowledge of district curriculum on all levels preferred.
- Demonstrated skill and creativity in curriculum development and in planning, designing, producing, and evaluating audiovisual and electronic courseware.
- Knowledge of current research in areas of responsibility.
- Demonstrated management and communication skills.
- Such alternatives to the above qualifications as the district may find appropriate and acceptable.

Job Goals:
- To optimize the educational experiences in the district through the effective infusion of technology into instruction.
- To evaluate the status of technological impact in instruction, identify needs, and make recommendations.

Performance Responsibilities:
- To work cooperatively with other program managers to ensure the integration of technology into the district's instructional program optimizing quality and creativity.
- To coordinate and supervise "teachers on special assignment" [a roving technology support team] in providing instructional technology service to schools.
- To coordinate the design of an evaluation instrument for audiovisual and electronic courseware.
- To supervise the identification of courseware and activities related to the use of technology in instruction.
- To design a computer literacy skills continuum.
- To establish procedures for the purchase, replacement, and repair of instructional technology equipment in cooperation with appropriate departments in the district.
- To develop, implement, and coordinate in-service experience in instructional technology to district staff.
- To develop budget in areas of responsibility.
- To assist the executive director in meeting the department's program objectives.
- To perform other duties as may be assigned by the executive director.

Evaluation:
Performance of this job will be evaluated annually in accordance with board policy on evaluation of professional personnel.

Tips

Administrators should be aware of two areas of serious concern to computer coordinators: an uncertain job description and lack of appreciation from the boss. These concerns were expressed by a group of 200 computer coordinators attending the 1983 annual meeting of the Minnesota Educational Computing Corp.

Many of the coordinators complained that their bosses "don't realize how much time the job requires." Many of the participants said they have to teach full time, in addition to serving as coordinators. Others said they were given only one class period a day to perform their new job.

The Minnesota guidebook, *Planning for Educational Technology,* noted some additional concerns about personnel in education technology programs:

Level of position: If the positions are full time, the district will have to decide whether to treat them as teaching or administrative positions. Tenure and credit for service are important items to consider here.

Compensation: Personnel costs will vary depending on the type of personnel involved and whether they are spending full time on technology utilization. In some districts, the guidebook notes, the personnel costs will simply be reflected in additional positions in the budget. If the personnel involved do not spend full time on technology, other forms of compensation can also be considered, the guidebook advises. Two popular options are extracurricular contracts or release time.

Keeping the person in the job: "These positions are excellent training grounds for similar positions in the private sector which pay very well, so the level of salary may be critical if the district

wishes to protect its investment over the long term," the guidebook notes.

Cutting the cost: Some districts may want to consider sharing the cost of technology personnel with neighboring districts. The disadvantage of this arrangement is "the inevitable difficulty of scheduling time so that training needs are met without imposing an unwieldy schedule on the shared staff person," the guidebook points out.

Other Positions

In addition to a district coordinator, districts should also consider establishing these personnel positions in conjunction with a technology plan: trainers, building contacts, technology lab aides, and clerical support.

That is the recommendation of the Minnesota guidebook. It describes the responsibilities of these additional staff members:

Trainers. Responsibilities: to cooperate with the district coordinator and administrative staff in planning, organizing, and providing inservice programs for using technology in the district. The handbook says that these persons, a selected core of support personnel, could be trained by the district coordinator (in very small districts) or by outside consultants (in medium to large districts).

Building contacts. Responsibilities: to provide immediate on-site support for teachers; to schedule equipment and materials; to serve as part of the district support network for technology; to help develop and control the technology budget; to guide building-level selection of equipment and the organization and updating of materials.

Technology lab aides. Responsibilities: to make sure equipment in labs is in working order and to recommend service when necessary; to maintain supplies and keep the labs clean and orderly; and to help maintain a schedule for equipment use. The handbook advises that these jobs could be filled with non-professionals, but that the positions should be paid.

Clerical support. Responsibilities: to handle the clerical duties needed for implementation. The number of clerical support staff needed, the handbook advises, will be determined by the number of other technology staff members.

Note: All of the duties suggested above will have to be carried out by someone if the district's plan is to succeed. However, as noted in the handbook, "the actual distribution of responsibilities will be largely determined by how far along the district is in using technology in education."

School District Practices

In implementing its technology program, the Jefferson County Public Schools, Lakewood, Colo., hired a resource specialist in instructional technology at the district level, assisted by four roving "teachers on special assignment."

In addition, each school is served by a building level consultant, whose main job is to provide training/consultation to other staff members who use that school's microcomputers.

A staff report prepared for the district recommended that building level consultants have the following characteristics:

- Interest in computer technology and the instructional use of microcomputers.
- Ability to communicate effectively with adults.
- An ability to provide encouragement to other staff members who may be reluctant to learn about a new technology.
- Willingness to attend priority inservices to be offered during the regular instructional day with emphasis on installing, using, and programming microcomputers.
- Willingness to devote time after regular school hours, with pay, to provide inservice training to school staff.

Cupertino: Lead Teachers

"The lead teacher network is the brightest idea we ever had," said Bobby Goodson, computer resource teacher for the 10,000-student Cupertino (Calif.) Union School District.

The network brings together, once monthly, a lead teacher from each school in the K-8 district, Goodson said in an interview for this report. The lead teachers talk over concerns and learn about solutions to problems they themselves have identified. Some examples: The meeting for one month was devoted to printers — how they work, spotting problems, getting maximum benefits. The meeting for another month focused on applications of the Logo programming language. Three district teachers explained how they integrate Logo activities into their classes.

The lead teachers are responsible for sharing their newfound knowledge with other staff members.

The lead teacher for each school is chosen by

the principal — a change in policy from previous years in which volunteers filled the job. Now, Goodson said, principals are asked to name the person based on several criteria: ability to communicate with peers, respect of peers and the principal, knowledge and comfort in using computers. Often, Goodson said, the lead teachers are also the computer leader in their schools because of their activities and their interest in technology.

By changing the criteria and shifting the selection of the person to the principal, Goodson noted, "we have a much more active group than formerly."

Lead teachers do not receive a stipend for accepting the job. But they are given staff development credit (i.e., credit on the salary scale). The credit also may be translated into credit for classroom supplies (for items teachers usually pay for themselves); a day off (for professional, not personal, use); or credit for conference expenses.

Houston: Teaching Technologists

The goal of the "teaching technologists" program launched by the Houston (Tex.) Independent School District is to prepare campus technology experts who can assist other teachers, students, and parents.

The technologists spend about half of the day consulting with teachers and the other half providing direct instructions to students, according to Associate Supt. Patricia Sturdivant.

The program was initiated, in part, because of the district's rapid installation of microcomputers and a graduation requirement mandating computer literacy for all students entering the 10th grade.

The district outlined these specific duties for the technologists:

- Training building staff, parents, and students in the use of technology.
- Training building staff in the selection and use of appropriate software.
- Evaluating software for possible purchase.
- Troubleshooting problems.
- Coordinating purchase of computer resource materials.
- Planning for increased technology utilization at the building level.
- Serving as liaison between the school and the district's Department of Technology.

Thirty-two persons were selected for the first training program; by 1987, the district expects to have a certified technologist for each school campus.

District criteria for selecting teachers for the training include: one year of instructional computing and two years of classroom teaching experience; proficiency on the Apple II microcomputer (no programming skill required); typing

'Messing Around': A Way To Leap from Old to New

How can we make best use of the new technologies?

An answer to that question comes from Lewis A. Rhodes, formerly associate director of Project BEST, a federally funded technology effort.

Rhodes directed his answer to state education agency personnel, but it applies equally to all school administrators, board members, and teachers. Here's what he had to say:

"We need to know how to use these tools, and we also need to have opportunities to 'mess around,' to try them in different situations or with different problems. In other words, we need opportunities to think about and integrate the technologies into our problem-solving processes — to develop a sense of what *we* can do with them.

"If we ourselves do not discover what can be accomplished with these new tools, there is a higher probability that they will be applied only to reach the 'old,' more limited objectives we are already achieving without them. Much like architects in the years immediately following the invention of the elevator, we might be putting elevators in two- or three-story buildings.

"Our experience at the receiving end of these processes is an important influence on the way we later apply them ourselves and is qualitatively different from the experience of learning how to teach or manage in an instructional situation."

speed of 30 words per minute; willingness to attend late afternoon and Saturday sessions; and recommendation of the principal.

Those selected are required to attend 74 four-hour modules or a total of 296 hours of training. Heavy emphasis is placed on literacy (48 hours of training required), programming (48), instructional applications (24), emerging technology (16), and field based/self study (76).

Each technologist is also required to attend 30 hours of "renewal training" annually. The district provides this training during the school year and the summer.

Technologists do not receive extra compensation for the training, but those who pass the program are guaranteed an annual stipend as long as they participate in the 30 hours of renewal training.

In planning for inservice training, other districts should take note of the assumptions on which Houston's approach is based. They were outlined in the *AEDS Journal* (Fall/Winter 1983) by Patricia Sturdivant:

- **Literacy.** Not all staff members need the same set of competencies.
- **Applications emphasis.** Training emphasis is on existing applications, not on program development. Teachers and administrators learn how to become computer users, not developers.
- **Training for principals.** The district requires all principals to participate in 20 hours of training in computer literacy, planning and decision making, hardware and software selection, evaluation, implementation issues, emerging technologies, and information sources. Also available to principals are optional courses (e.g., word processing, data management, telecommunications).
- **Content orientation.** Efforts are made to recruit teachers from all disciplines, not just mathematics and science.
- **Accountability.** One teacher assumes lead responsibility for the coordination of computer resources at the campus level.
- **Self-study.** Teachers are allowed to check computers out so they can gain more computer proficiency at home.

Staff Development

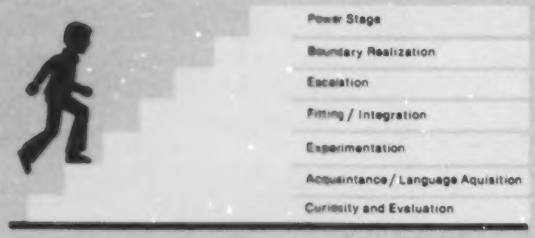
The Washington State Department of Education identified 10 principles of effective staff development that apply to any subject or field. They are:

- Decision making about inservice is a shared responsibility involving those affected as well as those responsible for administering and delivering the program.
- Programs are related to the participants' assignments and needs and are school based rather than college based.
- Participants are actively involved in the inservice activity as co-helpers and/or co-learners.
- Provision is made for adequate release time during the school day, adequate support services, and essential resources.
- The expected outcomes and objectives of the inservice are explicitly known before the program starts; they are evaluated after the program ends.
- Inservice activities are planned, continuing features of a comprehensive, districtwide staff development program.
- Opportunities exist for individualization within the program and permit some degree of self-direction and self-initiative.
- Staff development programs are not isolated, one-time events; they always include provision for appropriate follow-up and/or supervised activity.
- The individual or agency that will deliver the staff development is involved with others (see the first item) during the planning stages.
- The district/building level administration makes known its purposes and commitment regarding the staff development program.

A Model from New York

The Center for Learning Technologies, New York State Education Department, recommends a six-step model of staff development in its guide, *Getting Started: Planning and Implementing Computer Instruction in Schools:*

Step #1: Identify required faculty computer competencies. Start by identifying what students need to know. Then, prepare teachers and administrators to deliver appropriate instruction. *Be mindful that you will need to set priorities in terms of who will get what training according to what timetable.* For example, if your district intends to introduce word processing in ninth



How Computer Literate Are You?

Where do you fit on the "Microcomputer User Learning Curve?" Thomas J. Gambino, executive vice president of Micro Mainframe, Inc., Cambridge, Mass., described the seven-stage learning curve at a technology conference in Reno, Nev., sponsored by the Council for Exceptional Children.

The curve is intended to gauge the computer competency of adults (who, unlike children, have to relearn some skills in order to use computers).

The stages, along with the characteristics of persons at each stage, follow:

1. Curiosity and Evaluation — You're asking questions like: "Should *I* use a micro?
2. Acquaintance and Language Acquisition — You no longer fear you can "hurt" the machine by touching it.
3. Experimentation — You want to sit down — "maybe with a chauffeur."
4. Fitting and Integration Stage — You've learned to use the computer as a tool for your job. "This is the "critical stage," according to Gambino. If you've reached this point, you are on your way to becoming a sophisticated user.
5. Escalation — You've made "a real personal commitment of resources." For example, you've already built your first "real world" database of usable information.
6. Boundary Realization — You've made maximum use of the tools (machine and peripherals) and software you have. You want to move on, but you need someone to guide you to better software, better equipment, better application.
7. Accomplished or Power Stage — "Computers are no big deal" to you. You have reached the point where you can decide whether the computer is the appropriate tool to solve the problem at hand.

How do you get past these stages or support others in doing so? Gambino offered these tips:

- If you have to get a person past stage 3, have him or her do something practical and simple, but meaningful, on a micro. An example: Put into the computer and print a short letter to send to friends with Christmas greetings.
- To get past stages 4 and 5, the potential user must have what Gambino called "a friendly teddy" — someone to talk with and "lead you in the right direction." The person should be able to take the micro home to play with "and become comfortable with," Gambino suggested. Make sure a knowledgeable person is available by phone to answer questions.

grade English as its first priority, you will need to train ninth-grade teachers in basic hardware and software, and also train them in using word processing software to develop writing skills.

Step #2: Determine existing faculty computer competencies. This will give you an idea of needs and, in addition, identify persons who would make good trainers or assistant trainers.

Step #3: Cluster required computer competencies. When you have determined which competencies need to be taught to which faculty members, you should be able to cluster competencies, with, for example, the first being basic hardware and software literacy, the second being applications, and the third, programming. (For more details and some other ideas, see "What To Include" below.)

Step #4: Develop and provide training programs. This will require you to arrange for trainers, scheduling, facilities, equipment, and software.

Step #5: Develop and provide other staff ac-

tivities. Here are some examples: Providing publications to give staff the opportunity for self-education; allowing staff to attend technology conferences; arranging for them to visit classrooms in their own and other schools to observe exemplary uses of computers and other technology and to talk with teachers and students; arranging for them to work/team teach with a colleague; supporting the activities of computer user groups; arranging for staff to spend school time swapping information and experiences and developing instructional strategies and materials.

Step #6: Evaluate staff development activities. Rather than have the participants fill out an evaluation form at the end of the staff development program, the Center recommends that you focus on whether staff members can perform the skills they are required to teach their students. Other ways of determining that the staff development activities are accomplishing their objectives include: peer evaluation through observation and retraining, interviewing a small sample of faculty members to identify strengths and weaknesses of staff development activities, and soliciting self-assessments from trainees.

What To Include

How much and what kind of training do teachers need? As noted in the New York guide, the level and type of training will vary, depending on the district's plan, the school's implementation schedule, and the teacher's grade level and instructional responsibilities.

"The level of computer literacy depends on how the teacher will use the computer," advises the Minnesota School Districts Data Processing Joint Board (also known as TIES), a nonprofit consortium of approximately 60 member school districts in and around Minneapolis/St. Paul.

"Some teachers," it explains in its *Computer Literacy Curriculum Guide, Grades K-9,* "may only need to know how to start up a computer, while others should be familiar with a programming language."

But, it adds, wherever a computer can conceivably be used in a classroom, that teacher should have a minimum level of computer literacy. This would include, it says, the ability to set up the computer system for operation, run software with documentation, and choose software for its appropriateness to the classroom and topic.

The organization further defines three levels of computer literacy for teachers and the abilities necessary for different applications. (See the box, "Levels of Computer Literacy," in this chapter.)

Ingredients

A federally sponsored study on the effective use of microcomputers in special education listed the ingredients that researchers found in effective *introductory* courses for both special education and regular education teachers. They are: microcomputer operations and features, running CAI (Computer Assisted Instruction) software, integrating computers with the curriculum, how to select and acquire software, and how to save programs. For *advanced* courses, the researchers said these topics are effective: programming (especially BASIC), authoring languages, word processing, Computer Managed Instruction, and other administrative applications. The study was conducted by SRA Technologies (901 S. Highland St., Arlington, Va. 22204).

Introductory Course

What do you offer in an introductory computer literacy course for teachers and administrators? A sample syllabus for a three-day course is offered by the Technology Lighthouse of the Merrimack Education Center in its guide, *Computer Applications Planning.* The course is intended for teachers and administrators who have little or no previous knowledge or experience with computers.

Following is a list of suggested topics:

First day — Introduction; initial computer experience (hands-on experience with micro and minicomputer); computer competencies; history and training; and classifying software for Computer Assisted Instruction.

Second day — Hardware systems (demonstration); software review; and classroom applications.

Third day — Classroom applications (design of instructional applications by small groups); and implementation strategies.

See *Computer Applications Planning* for more detail (available from the Center, 101 Mill Rd., Chelmsford, Mass. 01824; $9.75).

What not to do in an introductory session. One principal told a national computing conference that he learned during one summer inservice course how *not* to make teachers computer literate. Here is his report:

An outside trainer conducting the sessions led off the first day with these remarks:

"Nice to have you here.
"I want you to know that we are going to be starting with the language called BASIC. It is the language that most microcomputers use, and we know that you are going to enjoy learning it.
"You won't have a hard time at all learning BASIC. After all, look at all of those kids out there who are already using BASIC."

What happened immediately, the principal said, was that "half of the teachers were sitting in a slightly catatonic state; the other half were saying, 'If I don't learn this language, I'm a dummy.'"

Nevertheless, the principal noted, "we continued with the BASIC programming for all 10 lessons and when we finished we sent those 'computer literate' teachers back into their classrooms to 'apply computer literacy' and to teach the students 'to use computers as problem solving tools.' After all," he added, "this is what the district told us we should be doing with our computers.

"What we learned," the principal continued, "is that programming is not easy to learn, that the teachers did not become computer literate, and that the inservice was a waste of time.

"We also concluded," he said, "that principals like myself need at least a year's worth of activities, inservices, and projects — things that will involve them in what is happening in their schools in relation to computers. Then you might have someone out there who can take a leadership role and help teachers see that the computer is indeed a problem-solving tool that can do wonders for their school."

Overcoming Computerphobia

"One of the reasons teachers and administrators have been slow to learn about computers is fear of the unknown, fear of replacement, fear that is a combination of 'math anxiety' and the assumption that computer work lies primarily within the area of mathematics teachers." That statement comes from the "Report and Recommendations of the Texas Legislative Subcommittee on Changing Technology in Instruction."

LEVELS OF COMPUTER LITERACY

LEVEL OF COMPUTER LITERACY	Can operate computer.	Can choose software.	Can run software.	Can evaluate software.	Knows computer terms.	Understands basic computer operations and capabilities.	Can use authoring languages or packages.	Can write programs.	Can develop microcomputer courseware.	
LEVEL I	X	X	X							Uses CAI in the classroom.
LEVEL II	X	X	X	X	X	X				Provides information about the computer and uses CAI.
LEVEL III	X	X	X	X	X	X	X	X	X	Instructs students about computers and languages, uses CAI, and develops instructional courseware.

Source: *Computer Literacy Curriculum Guide, Grades K-9;* Minnesota School Districts Data Processing Joint Board, St. Paul. Reproduced with permission.

The report says teachers and administrators can reduce and eliminate these fears by learning more about microcomputers and having hands-on experience with them. "Trainers can help," the report adds, "by reminding teachers that the microcomputer resembles a cross between a typewriter and a television — both familiar and comfortable objects."

One superintendent offered this cure for computerphobia: "Get teachers to sit down at computers. Once they do this, they grow comfortable with them."

Other suggestions came from Ruth K. Landa, president of Brainbank, Inc. She told a technology convention audience that teachers' fear of computers would disappear if schools explain that computers (1) permit educational programs to be tailored to each student's needs; (2) relieve teachers of administrative, time-consuming chores; (3) never show signs of frustration; (4) act as a cadre of assistants for teachers; (5) are silent servants; (6) are an ally, not an adversary; and (7) serve as friendly partners.

Most administrators and computer coordinators advise that staff development activities in computer education should be voluntary. Some say that many of the staffers who are determined to "stick it out without getting involved with computers" may eventually become curious about the enthusiasm of their computer-using colleagues. Or they may not.

Districts soft-pedal computer awareness and training for timid or reluctant teachers in numerous ways. Some examples:

- Allowing teachers to take computers home at night, on weekends and holidays, during summer vacation. One coordinator noted: This gives the teachers a chance to spend as much time as they want "and to make their mistakes in private." And, quipped Ken Brumbaugh, executive director of the Minnesota Educational Computing Corp.: "Allowing teachers to take computers home for the first two weeks they are in school allows them to get acquainted with the machines and gives them a chance to stay ahead of the kids for at least a day."
- To make teachers comfortable with computers, Santa Monica (Calif.) High School established a lunchtime series of "brown bag meetings" in the computer lab for teachers to discuss and try out simple keyboard programs, see films, talk, and socialize in the computer lab environment.
- The Phoenixville (Pa.) Area School District "enticed" the general faculty to become acquainted with computers, said Stephen R. Gring, curriculum coordinator, by purchasing recreational software such as blackjack and disco music. Then, he said, a "more serious" phase ensued, and the district offered a formal five-hour inservice program to all staff members.
- A San Diego computer coordinator placed a computer in a corner of her office and issued an invitation to teachers to "come try it out anytime." The idea worked, she said, because the teachers liked the idea of having a "private" place to experiment and having her as a tutor when they got stuck.

In-House Staff Development

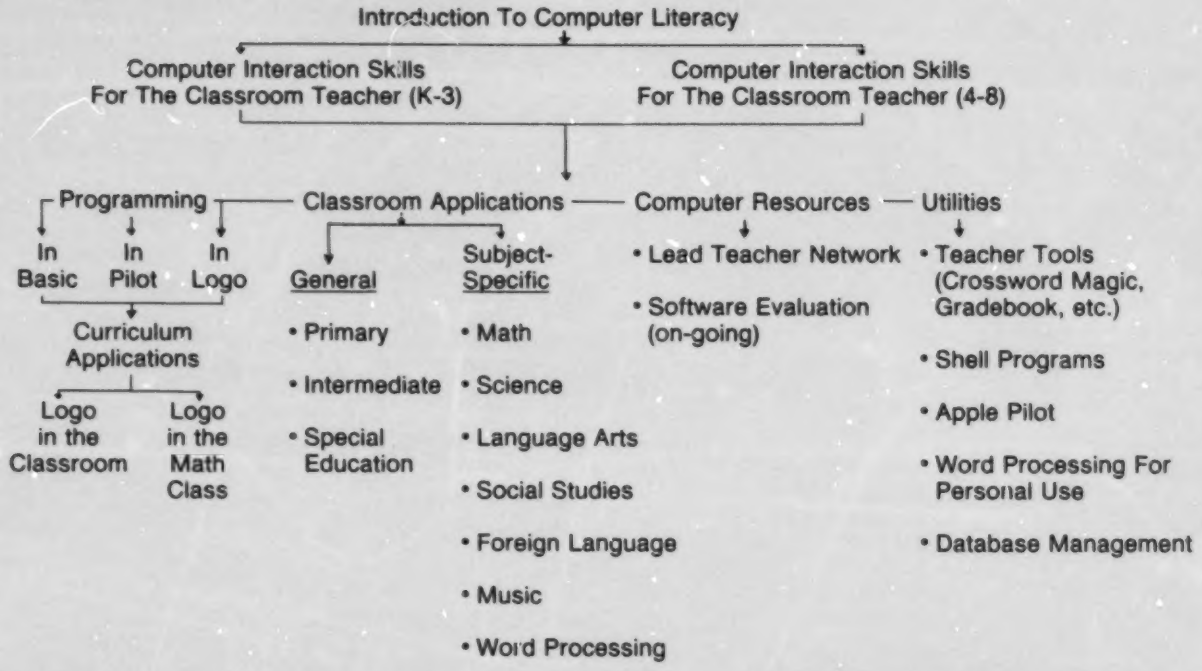
The Lyons Township High School District, LaGrange, Ill., started its microcomputer training sessions for teachers by bringing in an outsider who trained eight teachers. These teachers became an in-house teacher corps responsible for training the remaining 240 teachers on the staff. The district provided 20 hours of training over a 15-month period in a series of sessions, starting with awareness and general information and proceeding to content, demonstration, practice, and feedback.

When teachers finished the series, they could request individual coaching in unlimited amounts. Estella Gahala, district director of curriculum and instruction, noted that the teachers gave each other "admirable support." And although some teachers were reluctant and grumbled about the training, she said, "all wanted to do well individually and collectively."

Under the district's plan, all teachers of second period classes were required to teach a four-lesson computer literacy unit. The teachers could decide whether to teach it on four consecutive days or on a staggered schedule (one period for four consecutive weeks). The district provided review and reinforcement training to teachers; in addition, teachers could request to have a backup person available in the computer lab in case of a malfunction. Gahala noted that every teacher carried out the computer literacy instruction on schedule and not one case of "electronic flu" was reported.

Gahala details some of the lessons learned by the district in its initial efforts to develop a computer literate staff: Staff members were much more receptive to being taught by their peers than by an outside specialist; keyboard skills became evident as a factor in experiencing success; facul-

Cupertino Union School District
Computer Inservice Design



ty training should emphasize use and applications of computers, not programming; the effectiveness of the computer literacy program for students is strongly dependent upon the attitude of the teacher with whom students are in contact.

Comprehensive Model

The computer education program in the Cupertino (Calif.) Union School District is a nationally recognized program whose teacher training component was validated as successful by a federal review panel in the spring of 1984. The program evolved from a federally supported Title IV-C project that started in 1977.

Staff development is comprehensive and wide ranging. Teachers and administrators may choose from a wide variety of courses which are offered after school and on Saturdays. A district catalog described 12 different computer courses, for example, that were scheduled to be offered simultaneously. The courses, all free for staff members, ranged from "Computer Interaction Skills for the Classroom Teacher" to programming in several computer languages to "Database Management Programs in the School." (See the box containing Cupertino's "Computer Inservice Design" in this chapter.)

In addition, any school may request a workshop or course geared to the specific needs of its staff, according to computer resource teacher Bobby Goodson.

"Computer classes are scheduled for staff at least three days a week throughout the school year," Goodson said. Teacher participation has been high — 85 to 90 percent of all district teachers have been involved in some of the training.

Goodson advises other districts to "go slow" in implementing a program. The biggest problem for districts starting new programs, she added, "is probably their desire to go too fast — to push their teachers too fast and to expect too much.

"Teacher training," Goodson advised, "isn't a problem unless the district tries to teach all teachers everything in the first year." Instead, she advised, "try to teach awareness to the teachers who want it the first year. Then, in the second year, you will have a nucleus who know what you

taught the first year and will support the teachers who are willing to try it, too." By the third year, she noted, "you have teachers who will take over teaching the introductory class while you go on to something else with those who are ready for it.

"There isn't a better instructor in the world than one of your own teachers," she said, "because they understand the problem. Because of the boost in morale and recognition that you are giving to these teachers in allowing them to teach their peers," she noted, "you will find a lot of positive things happening in your school district in addition to helping your computer program."

Other advice from Goodson:

- Give only small segments of training at a time. "In the beginning, try to get teachers to sign up for 1 four-hour course or 2 two-hour courses to develop their awareness; then try to get them hooked for another four-hour course." They will sign up, she said, "since the first four hours didn't hurt."
- Allow teachers time for classroom experience after they have taken several classes "to get comfortable" with the machine and software. Then they can share what they have learned and take more classes.
- Ease teachers into the use of computers. One way is to put a computer in the teachers lounge. When they find personal uses for the machine (e.g. computerized grade books, discipline reports), they'll be more interested in exploring curricular uses.
- Don't expect the principal to lead the computer program in his or her school. "It's a rare principal who has the time away from administrative details to take an active role in a piece of the instructional program," she noted. However, principals' interest and knowledge will increase substantially "if they get a computer in their office and can see some use for it in their own work. Then," she said, "they also become interested in classes that can help them" (e.g., database management, word processing).

Many Inservice Options

In response to the survey for this report, John W. McConnell, coordinator of educational technology for the 4,300-student District #225, Glenview, Ill., offered this sketch of his district's training activities.

"Our district offered the first course in microcomputing three days after we acquired our first 16 microcomputers. The first 2 one-week sessions were conducted by the vendor, who had been required to provide training for one teacher per machine as part of the bid. At the third session we had a staff member take over the training with a session for administrators. By the end of the summer, 90 staff members had gone through at least 10 hours of training.

"During the next school year, we released staff members for full-day sessions," he said.

"In 1981, our board established two courses for salary credit." The courses are "Microcomputers in Education" and "Programming in BASIC for Education." They are taught by the coordinator of educational technology.

"Special sessions on word processing and business applications have been given after school. Our feeder elementary school districts and our community college have joined our sessions," he continued. "Our local consortium, Microideas, also offers special courses for our teachers.

"We sent two teachers to training sessions provided by Digital Equipment Corp. for use of our instructional minicomputers. This year, we have sent teachers to training sessions on Pascal, offered by Digital, in preparation for teaching this language. The teachers who are trained then become the trainers of others," he concluded.

Tips

- **Tie implementation to the number of teachers trained.** In other words, introduce equipment into a program on a schedule which is controlled by the speed at which teachers can be trained to use it. This recommendation comes from the Community Advisory Computer Committee of the 16,500-student School District 4J, Eugene, Oreg.
- **Be mindful of the changing emphasis in staff development.** A distinct change has taken place in staff development activities in computer education, according to Todd Hoover, assistant professor, School of Education, Loyola University of Chicago. Writing in *Educational Computer* magazine, Hoover says the training sessions of the late 1970s were geared toward computer programming and the evaluation of hardware.

Now, he notes, "the task of purchasing hardware is either already done or delegated, and the teaching of computer programming to teachers is less necesssary now since teachers rarely need to write their own programs."

Currently, Hoover says, the teacher who participates in a microcomputer inservice session for the first time needs training in three general areas: (1) setting up the hardware and running

selected software correctly, (2) properly evaluating software prior to purchase, and (3) developing a strategy for integrating the computer into the existing curricula.

• **Programming:** David Moursund of the University of Oregon offered this advice on teaching teachers to program in an interview for this report: "If we have the opportunity to put a teacher into a full semester-length course of three credits or a quarter-length course of four credits, and if we know that that's our only formal shot at teacher education — whether pre-service or in-service — approximately one-third of the content of that course might be in computer programming. So the course is not a computer programming course . . . Persons leaving that course, if they take no additional training in the computer field, will most likely never write a program afterwards and will not be responsible for either teaching programming or developing software materials. If we don't have that type of opportunity with the teacher in offering a full course, then we probably are not going to teach any computer programming at all.

"If you have teachers in a two-day workshop and that is the entire formal training they are going to get," he added, "computer programming is not the right thing to be doing during that time."

• **How much inservice training?** Inservice education must continue beyond the initial effort, Moursund said. "The level of knowledge needed when there is only one microcomputer per 120 students is quite different from what is needed when there is one microcomputer for every 10 students. This will require extensive inservice education as well as funds to support curriculum development and revision."

• **A good purpose for public domain software** is to have teachers look at it in inservice sessions in order to learn to evaluate software.

• **Trainers cannot treat teachers all the same.** "Differing staff reactions create conflicting demands upon the manager of a computer education program," according to Estella Gahala, director of curriculum and instruction for the Lyons Township High School District, La-Grange, Ill. In a report on the district's computer literacy program, she says: "Enthusiasts want more and more learning and developmental opportunities and are, in fact, insatiable consumers of all resources offered. Others want to reject the value of the computer literacy objective and do what they can to subvert progress toward the goal. Yet both play a positive role in program development. The first group forces the planners to think big; the second group forces the planners to think carefully."

• **"Most teachers want to improve the education process, but they are also trying to survive,"** noted an inservice training specialist. "Teachers often feel that their classroom schedule is already full, so their question to the trainer will be: 'What can I not do, if I am going to start to teach with or about computers?'"

Implementation

What steps can district administrators take to ensure smooth and lasting integration of computers and other technology into the regular curriculum? Here are some ideas from the New York State Education Department's Center for Learning Technologies:

• Schedule meetings where the faculty can discuss implementation difficulties with their colleagues and share ideas for dealing with them. Use these sessions to be sure that everyone has a clear understanding of the program.

• Provide teachers with sufficient time to prepare or adapt instructional materials for their own use. They may need time to practice using the software on the computer.

• Support the principal in the role of a facilitator and resource person to the faculty.

• Pay attention to what is actually happening in classrooms.Ensure that actual implementation is going according to plans.

• Keep faculty informed of program implementation activities throughout the district.

• Provide encouragement and support from the central office staff.

• Document implementation activities. What problems were encountered? How were they solved?

Chapter VI

Software

The size and importance of the investment in computers and the lack of quality software make choosing good software a critical issue for educators today.

Henry F. Olds Jr.
Evaluation of Educational Software: A Guide to Guides

Currently, school districts have a wide variety of sources for obtaining software or courseware. Seemingly everyone with a computer and some programming skills has gotten into software production — from the computer hobbyist working alone in a home office to Control Data Corp. — which in 1982 decided to make available on microcomputers some of its 8,000 hours of computer courses developed for mainframe computers over a period of 20 years.

So much software is being produced that anyone trying to keep up with day-to-day developments can spend a major portion of his or her time doing just that.

An even harder, and more necessary, task is determining the quality of what is being produced and whether it fits the needs of a local school.

The task is difficult for numerous reasons. Prominent among these are: the large and growing number of software programs and producers, the inability of many districts to keep up to date on new products, the refusal of many software producers to give out preview copies of programs, and the status of software evaluation.

Quality Software

Definitions abound for what constitutes quality in education software. For some evaluators, quality is determined by technical correctness. For others, the key factor is good instructional techniques. Quality, then, like beauty, sometimes "is in the eye of the beholder."

What do the pros advise in terms of determining quality? One definition comes from software expert Henry F. Olds Jr. He says four general features characterize quality instructional software. Here's how he describes them in *Evaluation of Educational Software: A Guide to Guides* (see the Resources List in this chapter):

1. Quality software should be the outgrowth of a fully conceived and carefully articulated "intellectual model of the content domain" (e.g., good science software should represent the best current scientific understanding).

2. Quality software should reflect an understanding of the cognitive developmental needs and capacities of the learner (e.g., younger children need more concrete representative experiences).

3. Since the computer provides an environment for interaction, its best pedagogical use should support the inherently interactive nature of knowledge construction for the learner (e.g., the computer is a poor medium for giving a lecture).

4. It should make use of the special qualities of computer technology in truly functional ways (e.g., use graphics to make an abstract concept concrete). It should not attempt to carry out instructional tasks far better suited to other media (e.g., it should not be a textbook).

How Good Is the Software?

Industry's first attempts at the development of educational software for the microcomputer brought less-than-positive reaction from reviewers.

An example is an evaluation of six large math

and reading software curriculum programs conducted in 1981 by the Microcomputer Resource Center at Teachers College, Columbia University. The evaluators noted that the programs did not specify who the intended users should be; the programs' objectives did not include higher order skills (e.g., comprehension, analysis); few of the programs taught concepts; none of the programs provided lesson plans or specific activities to integrate the program into the curriculum; and most of the feedback responses did not remediate wrong answers.

Today, the picture is somewhat different. Many experts say schools now have access to a much wider variety of better quality software.

Quantity. Initially, producers focused on software for elementary basic skills areas. There are still gaps in what's available, particularly for the secondary level and in areas such as science and social studies. Some of these gaps are now being filled, particularly by two sources: (1) small software developers, such as experienced science teachers who put their expertise to work in developing software, and (2) large-scale producers, such as computer manufacturers and textbook companies, which produce software to go with already available textbooks and other materials.

Quality. Both software producers and software evaluators attest to rapid improvement in software quality. To illustrate: Ken Brumbaugh, executive director of the Minnesota Educational Computing Corp. (MECC) said in an interview with the editor of *SchoolTechNews* in late 1983 that the most recent software produced by MECC was much better in many cases than that produced several years earlier. Brumbaugh explained: "We've learned a lot."

That point was reinforced by an experienced "software watcher." He claims that education programs are improving so quickly that he has to adjust his standards for quality software every 90 days.

The evaluator's point of view comes from Donald C. Holznagel, director of the Computer Technology Program, which is located at the Northwest Regional Educational Laboratory (300 S.W. Sixth Ave., Portland, Oreg. 97204). The program is best known for MicroSIFT, a federally funded software evaluation effort it conducts.

Holznagel said in an interview for this report that the quality of education software has improved in the past few years — "particularly on the technical side of things and also in the pedagogy.

"Far fewer programs are now coming out with 'bugs' in them; far fewer are unsupported by teacher and student materials," Holznagel said.

Consequently, Holznagel advised, districts should be looking at the newer programs. "Developers have learned a lot in the last couple of years, and the newer materials tend to be more complex and more flexible, and they tend to use several different modes of instruction." For example, instead of producing a software program that relies solely on drill and practice, developers are more apt to couch a mundane exercise in a motivational format such as a game.

This is not to say, Holznagel added, "that the older software isn't any good. But the newer the material, the better chance it will be technically good."

More evidence. The results of large-scale evaluation efforts can also provide some perspective on the issue of software quality and quantity. One example:

MicroSIFT had issued evaluations of 168 instructional microcomputer programs by the end of 1983. Each program was evaluated by knowledgeable reviewers on a number of criteria (e.g., accurate content, well defined purpose, ease of use). Of the 168 programs, 125 were "highly recommended" or "recommended for use with little or no change in the program."

A promising development is an ambitious undertaking by the New York State Education Department's Center for Learning Technologies.

The Center established an "early warning evaluation effort" in early 1984. The purpose, according to Gregory Benson, Center director, is to have educators critique software prototypes or ideas in the early stages of their development.

The process works like this: A software company submits an idea or program prototype to the Center; it convenes a team of 6-10 qualified evaluators to review the program; within 7 days, the Center sends an extensive evaluation report to the company; and the company pays the Center for all costs for consultants' time and travel. Everyone is sworn to secrecy to protect the company.

Locally Developed Software

Why do some teachers choose to create their own materials for microcomputers rather than purchasing "canned" software?

M.D. Roblyer, director of ICON Enterprises, an instructional computing consulting firm in Tallahassee, Fla., answers that question in *Educational Technology* magazine.

She says teacher motivation to create software comes from three sources:

1. Fulfilling expectations: Many people are telling teachers that this is what they *should* be doing and that "developing one's own programs is so easy that anyone can learn to do it."

In addition, Roblyer notes, many computer literacy workshops give teachers little training in how to use already prepared software, while furthering the idea that programming and creating software are essentially the same activity — one that teachers should pursue.

2. Saving money: Some districts budget almost all available money for hardware and almost none for software, Roblyer says. In addition, some educators question the high prices of some commercial software and therefore decide to become their own suppliers.

3. Filling the (perceived) gap: "In spite of the continuous efforts of commercial enterprises to fill the 'courseware gap,' many teachers are still saying there is little quality courseware available," Roblyer says. Strictly speaking, she comments, "this is not accurate. There are a great many materials available which have gotten good reviews from both evaluations and from classroom use."

"However," she adds, "specific teachers still seem to be having problems *finding* what *they* want and need." The problem here is partly logistical. Few school districts, she notes, have a group or individual responsible for locating soft-

Suggested District Policy on Software Copyright

It is the intent of _____ to adhere to the provisions of copyright laws in the area of microcomputer programs. Though there continues to be controversy regarding interpretation of those copyright laws, the following procedures represent a sincere effort to operate legally. We recognize that computer software piracy is a major problem for the industry and that violations of computer copyright laws contribute to higher costs and greater efforts to prevent copies and/or lessen incentives for the development of good educational software. All of these results are detrimental to the development of effective educational uses of microcomputers. Therefore, in an effort to discourage violation of copyright laws and to prevent such illegal activities:

1. The ethical and practical problems caused by software piracy will be taught in all schools in the District.
2. District employees will be expected to adhere to the provisions of Public Law 96-517, Section 7(b) which amends Section 117 of Title 17 of the United States Code to allow for the making of a back-up copy of computer programs. This states that "... it is not an infringement for the owner of a copy of a computer program to make or authorize the making of another copy or adaptation of that computer program provided:
   a. That such a new copy or adaptation is created as an essential step in the utilization of the computer program in conjunction with a machine and that it is used in no other manner, or
   b. that such a new copy and adaptation is for archival purposes only and that all archival copies are destroyed in the event that continued possession of the computer program should cease to be rightful."
3. When software is to be used on a disk sharing system, efforts will be made to secure this software from copying.
4. Illegal copies of copyrighted programs may not be made or used on school equipment.
5. The legal or insurance protection of the District will not be extended to employees who violate copyright laws.
6. _____ of this school district is designated as the only individual who may sign license agreements for software for schools in the district. (Each school using the software also should have a signature on a copy of the software agreement for local control.)
7. The principal of each school site is responsible for establishing practices which will enforce this policy at the school level.

Source: International Council for Computers in Education, University of Oregon, 1787 Agate St., Eugene, Oreg. 97403.

ware for teachers. Many publishers, moreover, refuse to provide review copies of software.

Another problem, according to Roblyer, is the tendency of some teachers to "reject prepared courseware in favor of doing their own because published products are 'not exactly what we want.'"

Should Teachers Develop Software?

No, Roblyer concludes. While it is possible to create materials with a minimum of programming knowledge, she notes, what is difficult "is creating courseware which meets high standards of instructional and technical quality and which has utility outside one's own classroom situation."

Roblyer summarizes her arguments against teacher production of software this way:

"In general, individuals working alone cannot compete in quality with well funded, professional organizations whose livelihood depends on the effectiveness of their products. But even if it were possible for teachers across the country to develop some level of usable materials, it may still not be a desirable trend.

"Teacher efforts and creativity," she says, "are better directed toward developing ways of making better use of computer materials in the classroom."

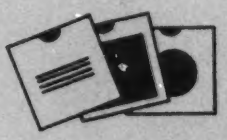
Another view comes from Donald R. Holznagel, director of the Northwest Laboratory's Computer Education Program.

"If teachers want to write software and have the time to do so, then they should be encouraged," he said in an interview for this report.

Teachers are still limited, however, by the amount of time they have available, Holznagel said. And, he noted, they may have a good idea, but cannot translate it into a good instructional design for use on a computer. "A teacher is not necessarily a good designer of one-to-one instruction," he said. Other limitations can be lack of graphics ability and not being fully aware of all the options available in designing instructional material.

"What you can expect from teachers," Holznagel added, "are excellent ideas." It is up to an administrator or computer specialist, then, to use these ideas in shaping the district's computer education program.

One superintendent who seconds this advice is John L. Bristol of Lyons Township High School District, LaGrange, Ill. "I don't want my staff



Tips on Obtaining Review Copies

Although experts advise schools and districts to request review copies of recommended software and to try it out with students before making a purchase, many companies will not grant such requests.

Here are options used by some districts:

- Ask for a demonstration disk (available at low or no cost).
- Purchase only the documentation.
- Purchase one copy for preview, before placing an order for multiple copies.
- Visit agencies with extensive software collections. (A list of agencies in each state was featured in *Electronic Learning* magazine, January and February 1984 issues.)
- For smaller districts: pool funds to buy software for tryout purposes.
- Set up local inservice workshops and invite other districts. Exchange information about software.
- Contact publishers and tell them when you are having workshops and inservices. Ask them to send salespersons to demonstrate programs you are interested in. Or ask them to find a user in your area who can demonstrate the program.
- Attend all the computer shows you can.
- Share your findings about software with other districts.
- Ask the editors of computer magazines to review the packages of interest to you.

Note, too, that some organizations and groups are urging school decision makers to purchase software only from producers and distributors with favorable purchase policies (e.g., free preview, guaranteed replacement of defective disks or cartridges, a 30-day money-back guarantee if the purchaser is not satisfied, a free back-up disk).

Tip: Your district may have a better chance of obtaining a preview copy if you send along with your request a written guarantee that you will not make an illegal copy of the software during the preview or after purchase.

programming computers," he said in an interview with *SchoolTechNews*. "I want them to tell me *what* to program, and I will find computer experts to do the programming."

In the early stages of the computer education program in Bristol's district, many programs were developed locally. But now, he said, "much of what we need is available." He added: "I won't write one program that is commercially available—and can do the job."

Locating 'Good' Software

A survey of school districts by the New York State Education Department revealed that schools and districts buy software on the basis of such things as cost, relationship to state curriculum, advertisements, recommendations from other schools, published reviews, correlation with texts in use, and whether it fits the hardware they've purchased.

Are these good reasons on which to base purchase decisions? Not necessarily. Some experts say, in fact, that some schools approach the software issue backwards. That is, they buy software and then try to fit it into the curriculum rather than basing purchases on needs.

But, that is changing. MicroSIFT's Donald Holznagel said he sees more and more districts using a "priority setting process" to determine their needs prior to purchase.

He recommended that districts follow a process in locating and evaluating software, such as the following:

1. Set and focus on some priority areas.
2. Search for available software to meet those priority areas.
3. Look for evaluations of the software you are interested in.
4. Do an in-house evaluation of the software.

Step #1: Setting Priorities

Holznagel said the burden is on school districts to determine their instructional priorities. School decision makers will have to answer these kinds of questions: *Which students will we serve* (e.g., all students or only certain groups, such as those needing remediation, gifted and talented, the college-bound)? *Which subjects or areas will we focus on,* (e.g., science, math, reading, problem solving)?

Step #2: Searching for Software

In searching for available software that meets your priority areas, here are some likely places to look:

- **Latest software catalogs.**
- **Computer manufacturers.**
- **Databases.** A prime example here is RICE (Resources in Computer Education), which is operated in conjunction with MicroSIFT. Searching such a database can be helpful to a district when it wants to know what kinds of programs

Trends in Software Development/Evaluation

1. The use of software design teams that include, for example, subject matter specialists, a coordinator/manager, programmers, graphics/sound technicians, and documentation writers.

2. Intensity of competition within the software industry rivaling that in the hardware industry.

3. District use of a "priority setting process" to choose software for instructional purposes.

4. Reluctance by software producers to give out free review copies.

5. Use of more sophisticated software evaluation methods by school districts.

6. Expansion in number of districts forming software evaluation committees.

7. Expansion in number of districts hiring software evaluation experts and trainers to conduct inservice training for staff evaluators.

8. Expansion in number of software evaluation courses offered by universities and by groups such as the Northwest Regional Laboratory's Computer Technology Program.

9. Expansion in the number of states offering recommendations on software to local districts.

10. Expansion in number of electronic databases offering evaluations of education software.

are available to meet the needs of students in a particular subject or in a particular skill.

- **Any other informed sources,** such as state or regional education agencies, users groups, clearinghouses.
- **Other schools and districts.** (Note: In some areas, this is done informally through a computer users group.) "Software which has been evaluated by other teachers and found useful is the most likely candidate for adoption," noted Bruce Downing, director of industry marketing for Commodore Computer Co., in *Commodore Magazine.* Many times, he noted, a school may be able to find another school with similar goals that has already evaluated many programs.

One way to choose software wisely — which will probably become more widespread in the future — is to share information through electronic communications systems. Henry F. Olds offered this example:

Imagine, for example, that I'm a sixth grade science teacher doing a unit on the study of bones. I would like to know if educators on the [electronic] network have either purchased or developed software themselves that might help me with my instruction. So, before I go home, I write a message for the network bulletin board and store it on the disk. Late in the evening, when the telecommunications rates are low, my message is placed on the board. At various times the following day, people all over the country read my request, and a number of them send me responses. The following morning, I check my mailbox on the network and find to my delight that seven different commercial programs have been recommended for various aspects of teaching about bones, and two teachers have sent me programs they have written themselves, which I can store on my disk and try out later.

Step #3: Finding Evaluations

To find evaluations of the software you are interested in, you can turn to sources such as MicroSIFT, RICE, state or regional evaluation centers, magazines and journals, and evaluation services such as EPIE (P.O. Box 839, Watermill, N.Y. 11976).

Many experts recommend that districts draw on several different sources for reviews of the same piece of software because of the variability of criteria used by reviewers, the different conclusions reached by reviewers, and the fact that many reviewers do not try out software with students.

Given the current stage in the growth of this technology, the strongest advice I can possibly give is for everyone to develop a critical capacity of his/her own . . . One must also spend time using software and attempting to apply, at least informally, one's critical capacity. I am constantly astounded by the number of educators I meet who seem to think that they can make intelligent educational decisions about computer software without taking the time to learn how to use the technology and become reasonably familiar with the software upon which the technology so completely depends.

— Henry F. Olds Jr.

Evaluation of Educational Software: A Guide to Guides

MicroSIFT follows these steps in evaluating software:

- Sifting — a first look at a program to determine that it is instructional in nature, will actually operate without problems on the appropriate microcomputer, and is complete with documentation (instructions for use).
- Description — a program successfully passing the sifting step would be described at this step, using a special MicroSIFT form. (It is included in *Evaluator's Guide for Microcomputer-Based Instructional Packages.* See "Resources" list in this chapter.)
- Peer review — MicroSIFT selects one of the sites included in its nationwide network of educators to evaluate a program, following criteria it developed. The evaluators judge whether they would use the program themselves or would recommend it for use at the grade level intended. They must also identify the strengths and weaknesses of the program. A summary review incorporating the evaluators' comments and recommendations is completed at the network site and sent to MicroSIFT.

MicroSIFT sends summaries of all of its evaluations to approximately 200 dissemination agencies nationwide. It is their job to distribute the summaries to districts in their areas. A list of the agencies serving a given state can be obtained from the MicroSIFT project. Copies of MicroSIFT evaluations are also available from Education News Service (926 J St., Suite #212, Sacramento, Calif. 95814). Contact it for more details.

Public Domain Programs: Almost Free

Sources of "almost free" software include some computer magazines and books, users groups, and unprotected materials developed by districts, universities, and educational service centers.

Thousands of programs have been put into the public domain and are therefore free for use, notes Bruce Downing, director of industry-marketing for Commodore Computer Co., in *Commodore Magazine.*

Most of these programs, Downing advises, are limited in scope and were developed for local use. Some, however, have been developed with state or federal funds, and some are of sufficient quality to be seriously considered.

Shortcut: Teachers and administrators can find this type of "almost free" software by working through groups that collect and screen it. A prime example is SOFTSWAP, a collection of public domain instructional software for microcomputers, jointly sponsored by the San Mateo County Office of Education and Computer-Using Educators, a microcomputer users group in California.

SOFTSWAP programs are evaluated by teachers and edited for accuracy of content, instructional value, good programming techniques, and effective use of the computer. Visitors to the San Mateo County Office of Education may copy the programs without charge, or they may be ordered by mail for $10 per disk.

For more information, contact SOFTSWAP Microcomputer Center, San Mateo County Office of Education, 333 Main St., Redwood City, Calif. 94063.

Another noteworthy source is the Young Peoples' Logo Association (YPLA) Software Exchange (1208 Hillsdale Dr., Richardson, Tex. 75081).

See *The Computing Teacher* (March 1984) for a listing of disks available from SOFTSWAP and YPLA and additional sources of public domain software.

Note: A problem with "almost free" software is lack of reviews of the material. Therefore, districts must often rely on good in-house evaluation methods to screen it.

Educators can also get access to the evaluation reports through the on-line RICE database.

Step #4: In-house Evaluation

Educators should depend on established software evaluation systems (e.g., MicroSIFT or EPIE) as *supplements* "to making their own informed choices (about software)," notes Henry F. Olds Jr. in *Evaluation of Educational Software: A Guide to Guides.* "They must never be substitutes for our own responsibility to evaluate."

An in-house evaluation may be sophisticated or rather simple, depending on the resources and needs of your district. You may be able to obtain review or demonstration copies of the particular programs you are interested in. (See "Tips on Obtaining Review Copies" in this chapter.)

To facilitate in-house evaluation, many districts adapt one of the numerous software evaluation forms available from organizations such as MicroSIFT. Another option is to choose the most appropriate items from several evaluation forms.

The extent of the evaluation effort and, in fact, the number and type of items included in the evaluation form, will be determined in large part by the district's commitment of time and money. Suppose, for example, a district wants three teachers to evaluate 200 programs, but it can afford to pay the teachers for only five days' work. This will mean that the teachers will have sufficient time to evaluate each program on only, say, 10 questions (none of them open ended) and a 3-point scale.

Tips on Evaluation

1. Choose evaluators with care; provide them with adequate training. The Alberta (Canada) Education Computer Technology Project, for example, requests school superintendents to identify teachers they would like to have involved in the project's evaluation of software. The project identifies additional teachers and also draws on volunteers.

The project recommends that teachers meet a

number of criteria, e.g., subject matter expertise, experience in using a computer in the instructional program.

The evaluators receive two days of training in a workshop conducted by the manager of Alberta's software clearinghouse.

The Technology Lighthouse of the Merrimack Education Center, Chelmsford, Mass., cites additional criteria for selection of software evaluators. It says: "Good software selection requires an understanding of evaluation and development processes. Other considerations relate to decisions in the areas of purchasing, distributing, and an understanding of copyright restrictions. The selection of software requires knowledge about instructional objectives and pedagogic considerations as well as computer capabilities."

2. Be sensitive to the most important criterion. "Evaluations can focus on trivial questions and avoid the big issues like whether any given package is a sensible thing to do with a microcomputer," cautions Robert Tinker, director of the Technical Education Research Centers, Cambridge, Mass.

"The single most important criterion is whether the given piece of software has substantial education value that cannot be achieved in print. This single criterion eliminates vast quantities of software and saves us the effort of detailed, painstaking evaluations of materials which fail this simple test."

3. Don't get carried away with the forms. Tinker advises: "There is no best form, and the focus of attention on the form distracts reviewers from answering the fundamental questions about software which can be answered without forms: 'Is it substantially better than text, what does it teach, is it appropriate, and is it accurate?'"

4. Consider different sets of standards to evaluate each different category of computer program. The standards that are used to judge drill and practice programs, notes Henry Olds, should differ from those used to judge simulations and computer language programs. He says standards are just beginning to develop and that they will *and should* change, as more sophisticated software and hardware emerge.

Note: Progress is being made in this area. For example, The Alberta Education Computer Technology Project (10053-111 St., Edmonton, Alberta, Canada T5K 2H8) developed a guide to help prospective buyers evaluate and choose word processing software for student use and another to evaluate accounting software. These guides are in addition to the *Evaluator's Guide for Microcomputer-Based Courseware*, which was developed by the project to evaluate most CAI programs.

5. Be ready to apply local criteria in addition to those appearing in standard evaluation forms, advises Donald Holznagel, head of the MicroSIFT project. One of these, he notes in the *AEDS Journal* (Fall and Winter 1983), is cost-related factors. "Cost worthiness," he says, "is a judg-

Resources

Evaluation of Educational Software: A Guide to Guides, a useful reference guide for teachers and administrators who are responsible for software evaluation. It provides information on 10 evaluation systems, including abstracts and sample forms for MicroSIFT, EPIE/Consumers Union, Minnesota Educational Computing Consortium, National Council of Teachers of Mathematics. Available from Publications Office, Southwest Educational Development Laboratory, 211 East Seventh St., Austin, Tex. 78701; 1983; $6.50 per single copy prepaid.

Evaluator's Guide for Microcomputer-Based Instructional Packages (developed by MicroSIFT); available from International Council for Computers in Education, University of Oregon, 1787 Agate St., Eugene, Oreg. 97403; 1982; $2.50. This guide can help those charged with responsibility for evaluating education software, particularly when used in conjunction with the 22-point rating scale of the MicroSIFT project for which it was designed.

RICE (Resources in Computer Education), an online information database, part of the Northwest Regional Educational Laboratory's MicroSIFT project. By late 1983, the database included information on approximately 2,000 software programs for use in elementary and secondary schools. The RICE database is available to subscribers to Bibliographic Retrieval Services, 1200 Route 7, Latham, N.Y. 12110. Tip: Check with your state education agency or intermediate unit to find out if either already has the service and could search the database for you.

Guidelines for Evaluating Computerized Instructional Materials: National Council of Teachers of Mathematics, 1906 Association Dr., Reston, Va. 22091; 1981; $3. This publication includes guidelines to use in reviewing software, a sample form to use in requesting software information from publishers, and a sample form to use in evaluating the documentation (instructions) that accompany a program.

ment that the apparent value of an item in the district or school situation is worth the purchase price. This depends greatly on the needs as perceived by the school."

A second local cost-related factor, Holznagel points out, is affordability. "A school may not be able to afford an item regardless of the fact that it is judged to be well worth the cost."

Another criterion to be considered, according to Holznagel, is congruence between the software and community expectations, curriculum, other instructional materials in use, and teaching styles and roles.

6. Require teachers to use the software with students as part of the evaluation process. This is "an absolute necessity," according to EPIE. It recommends these steps:

- Evaluators should write a statement "explaining why a piece of software is recommended or not recommended for purchase. In the event of a positive statement, include suggestions for optimal use that may have been apparent during the preview period."

- Attach this statement to the documentation of the software when it is purchased.

- Obtain feedback from teachers and students who use the software. Use this information to improve how the software is used in the future and to help guide purchase decisions. Attach a copy of this information to the documentation.

Software Copyright

"The educational software market must overcome two critical problems: allowing educational access to quality software in usable, cost-effective form while at the same time realizing vendors are suffering from unauthorized copying of software and documentation."

The International Council for Computers in Education (ICCE) issued that statement in mid-1983 along with its policy statement on network and multiple machine software. It urged software vendors to charge reasonable prices to educators for network-compatible versions of software and to offer discounts for multiple-copy purchases of software.

ICCE also called on software developers and vendors to:

- Include with every purchase a back-up copy to be used for archival purposes.

The quality and appropriateness of content of a software program — not necessarily the cost — are the most important considerations in purchasing software. The value of a program largely depends upon meeting the criteria that you, the user, decide are important to reach your specific objectives.

— Susan R. Dyer and Richard C. Forcier
Instructional Innovator

- Provide for on-approval purchases so that schools may preview the software.

- Provide software to regional or area centers for demonstration purposes.

Along with the policy statement, ICCE called on school districts to adopt a district policy on software copyright. It recommended that such a policy discourage illegal copying (sometimes referred to as "piracy") of software through such actions as teaching students about the ethical and practical problems caused by illegal copies, and refusing legal or insurance protection to employees who violate the copyright law. (See the full text of the suggested policy in the box in this chapter.)

Industry's case was graphically stated by the American Institutes for Research, Palo Alto, Calif., in a federally funded study:

"There are roughly 3 million children at each grade level in the 100,000 elementary and secondary schools in the country. At one extreme, where each courseware unit is usable by one student alone, a 10 percent market penetration would yield roughly 300,000 sales per year; this would allow inexpensive pricing for courseware requiring even hundreds of thousands of dollars to develop. If a single copy of a courseware unit were bought by each school and copied or networked, however, the corresponding estimate (over all years!) for that unit would be reduced to fewer than 10,000. This would require expensive pricing to recover several hundred thousand dollars of development costs, when added onto per-unit production, distribution, and marketing costs."

Policy Needed

Schools should have a selection policy for software — just as they do for books, films, and other materials. Such a policy can come in handy, for example, in explaining to the community how certain materials were chosen for use.

The following process can be used to develop a Materials Selection Policy:

1. The Board of Education makes a decision to develop and adopt a Materials Selection Policy.
2. The Board of Education or its designee appoints an ad hoc committee composed of representative segments of the school community: administrators, teachers, school librarians, parents, and pupils.
3. The committee is charged with the responsibility of developing a Materials Selection Policy. The charge specifies the final date by which the committee is to complete its work, and is to submit the draft to the Board of Education for consideration. The contents of these guidelines shall be made available to the committee.
4. The Board of Education studies the recommended Materials Selection Policy. The Board may wish to meet with the committee to discuss the policy statement.

The Board may ask appropriate groups to study the document with the Board for additional suggestions and refinement; for example, department chairpersons, established curriculum committees, the teachers association, the PTA, principals, school librarians.

5. The Board considers the committee recommendations and adopts a final written statement as the formal Materials Selection Policy of the Board of Education.
6. The Board of Education provides for the implementation of the policy. The superintendent or his representative is charged with the responsibility of disseminating the Materials Selection Policy to all appropriate staff members. In addition to providing staff with copies of the policy, familiarization meetings should be planned with staff to review the policy, respond to any questions, and to enable staff to respond constructively if they are the first to receive a materials challenge.
7. Provision is made to ensure a continuing dialogue between the school and the community regarding the policy. Activities are planned to make school and community personnel aware of the importance of the freedom to read, speak, view, listen, evaluate, and learn.
8. The Board of Education asks for an annual evaluation of the Materials Selection Policy to determine its continuing effectiveness and appropriateness.

What To Include

A Materials Selections Policy should include:

1. A statement indicating that the Board of Education is the governing body legally responsible for the selection of all materials for the school district.
2. A statement delegating the responsibility for the selection of materials to appropriate professional school personnel.
3. A statement of the philosophy or goals upon which the selection policy is based, together with the objectives of the selection policy. Such a statement might well define the rights and responsibilities of the various affected constituencies; i.e., students, teachers, and parents. A clear, specific statement of objectives provides firm guidance when potentially controversial materials are considered.
4. A statement defining the materials for which this selection policy applies.
5. The specific criteria for the evaluation and selection of each category of materials (e.g., supplementary classroom materials, library media resources, gifts, free materials).
6. A statement which delineates specific criteria for potentially controversial areas.
7. A statement describing the procedure for handling challenged material.

Chapter VII

Administrative Uses

In a survey of almost 1,500 school districts nationwide in 1982, the Educational Research Service (ERS) found that almost 90 percent were using computer technology for administrative purposes. The median date of the introduction of computer technology was 1972, according to ERS. An even earlier introduction was reported for larger districts and for districts with higher per-pupil expenditures.

A majority (59 percent) of the districts that used computers for administrative purposes either owned or leased equipment. ERS also found that 41 percent were purchasing services from an educational regional service agency, 29 percent were purchasing services from a commercial agency or college, and 15 percent were participating in a time-share arrangement. Most districts were relying on mainframes or minicomputers.

Some changes, however, are occurring. Some districts are giving building administrators computer capabilities they never had before by linking them to a large central computer.

Another change: Lower-cost microcomputers and recent advances in software for these machines have put "computer power" within reach of the smallest districts and, in some cases, individual administrators within a district.

"At present prices, it is a worthwhile tradeoff to purchase personal computer stations to reduce the general paperwork burden that inhibits productivity," says Stanley Pogrow, associate professor of educational administration, University of Arizona.

Writing in *The School Administrator,* Pogrow adds: "The ease of using new software makes it more feasible for individuals without technical background to use computers effectively."

Another reason to consider the microcomputer for administrative use comes from Chase W. Crawford, consultant, Management Information Services for the Florida Department of Education. In the agency's "Educational Administrator's Survival Guide to Administrative Uses of Microcomputers," Crawford points out that the storage capacity of some microcomputers is now equal to that of many older, full-size computers.

Potential Uses

In general, Crawford says, four situations would generally justify the use of a computer, provided that the task to be performed is of high enough priority to computerize. These are:

1. When massive amounts of data are processed through well defined operations.
2. When processing is highly repetitive.
3. When speed of processing is of great importance.
4. When the task to be performed is not practicable by other means.

The North Carolina State Department of Public Instruction groups the potential uses of computers for administrative purposes into three broad categories:

1. Traditional business data processing similar to that which exists in most large business and commercial concerns.
2. Management aspect of the instructional program, including student data that traditionally have been collected and maintained by individual teachers as well as guidance counselors and other support personnel.
3. Networking capability that can link individual schools to the system-level computer in addition to computers in other schools and agencies for information exchange and compilation of data.

Note: The Department offers a model for ad-

ministrative uses as one way to design a coordinated systemwide plan (see the model in this chapter).

Supt. Phillip E. Leahy, Englewood (N.J.) Public Schools, lists 69 possible applications of microcomputers for school management in *Administrative Uses for Microcomputers, Volume 1: Software* (Association of School Business Officials of the United States and Canada, 720 Garden St., Park Ridge, Ill. 60068; $10). Twenty-six of the uses are concerned with students (e.g., enrollment projections, discipline history); 19 with personnel (e.g., staff directories, calendar); 15 with finances (e.g., general ledger, state aid forecasting); and 9 with facilities (inventories, custodial schedules).

Current Uses

How are schools currently using microcomputers in administration? A clue comes from a survey conducted in the fall of 1983 by the Florida Department of Education. It revealed that all but 11 of the state's 67 county districts were using microcomputers for one or more administrative purposes. The top administrative uses, according to the survey, were (in descending order): student records, attendance, media management, school accounts, FTE (full-time equivalent) accounts, instructional records, property records inventory, textbook inventory, and grade reporting.

Examples

- The Sacramento City Unified School District installed a pilot attendance system in two large high schools after losing $680,000 in three months because of reduced attendance. Traditionally, teachers took attendance for the first period classes only, and the district received state funding based on these figures. The new system, consisting of a microcomputer coupled with classroom scanning devices, enables teachers to enter attendance records at the start of each class.
- Approximately 1,000 classrooms (grades 1-12) are using a computer managed instruction system in diverse areas, including math, science, social studies, English, and reading. The microcomputer-based system, known as CAM — Demonstration Evaluation Center, was developed in the Hopkins (Minn.) Public Schools and is now part of the federal National Diffusion Network. To use CAM, teachers must first commit themselves to basing their instruction on course objectives developed by curriculum groups and teaching teams. Teachers test the objectives on a regular basis, every two or three weeks. CAM has also developed techniques to assist teachers in identifying instructional strengths and weaknesses. (For more information: Marie Weld, Evaluation Center, Hopkins Public Schools, 1001 State Highway 7, Hopkins, Minn. 55343.)
- Approximately 48 percent of 182 school public relations practitioners responding to a survey by Clement J. Cleveland of Benton Harbor, Mich., said they were using microcomputers primarily for these activities: word processing, database management (e.g., sorting names for mailing lists), typesetting, and accounting activities. Using his own district as an example, Cleveland estimated a 60 percent net savings in costs to produce one district document (a staff directory) using a database management program on a microcomputer and an electronic typesetter.
- Many districts are mounting a war on truancy with computerized, automatic phoning devices that let parents know when their youngsters are absent. In New York City's Taft High School, the "phone robot" raised attendance 8 percent in a three-month period. In Chicago, Tilden High School reported an attendance rate of 86 percent after the installation of the machine, up from 80.5 percent a year earlier. In Cincinnati's Withrow High School, administrators said they hoped to cut absenteeism from 18 percent to 5 percent. The principal said he also intended to use the machine to send home all kinds of additional messages — good ones as well as bad.
- Many districts are using computers to cut energy costs by controlling HVAC (heating, ventilation, and air conditioning) systems, lighting, and hot water consumption. Here are some examples of reported savings: The Colfax (Calif.) Union High School — savings of $14,000 per year through reductions in electricity consumption and diesel use; Tupelo (Miss.) High School — savings of $90,000 per year by chopping electrical energy consumption in half.

Deciding If You're Ready

A prime consideration in any decision to computerize or to change the way computers are used for administrative purposes is people.

That point was emphasized by Supt. Donald L. Kussmaul of the Tiskilwa (Ill.) Unified School District. He identified the specific people in a district who determine whether attempts to computerize administrative functions will succeed.

- The office staff. "Staff must be involved from the beginning. They must be convinced that it will be an aid. If they are afraid of the computer and what it might do to them and their job, then the program will fail from the beginning."
- Auditors. "They have used computers for years; consequently, the auditors are a wealth of knowledge about successful computer programs. In many instances, they can refer you to programs that are presently working and individuals who can help in selecting a good program."
- Board of education. "Involve the board of education in assessing administrative computer needs. . . . Make board members aware of the time it takes to do the payroll or prepare for a board meeting and the routine functions that must be done every month. The board must be convinced that the expenditure for a computer operation will be of value to increase efficiency and/or create savings in the future."
- The administrator. "You must be convinced that the computer will be of value. You must be willing to endure the change and some confusion when going to a computer operation. If you are saying, 'I don't know anything about computers, this is all new to me,' and six months later you are saying the same thing, you must reevaluate your position and either get interested in computers or continue as you have. There is nothing wrong with continuing as you have. Don't make the mistake of going for computers if you are not convinced."

Florida's Crawford outlined other considerations in deciding whether to computerize administrative functions:

- Initial cost (the initial hardware and software cost might outweigh the benefits to be gained).
- Computer illiteracy (not knowing which functions can and cannot be performed by a computer).
- Computerphobia.
- Security (figuring out which methods to use to ensure limited access to data).

Specific Steps

The following steps in making a decision come from Crawford and other sources:

- Become computer literate. Recognize that computerphobia is a common problem that starts to disappear with knowledge and, particularly, hands-on experience.
- Enable other staff members to do likewise.

What's An Administrator To Do?

It's Monday morning; your phone rings several times. Here are some of the requests:

Item #1. Come up with a budget for a short term project.

Item #2. Project facility use and staffing needs (and cost figures) for both regular and special education programs.

Item #3. Give a speech to the PTA meeting tomorrow night.

Item #4. Come up with a system to keep track of the skills of all volunteers, so they can be matched with needs identified by classroom teachers.

How do you fill all of these new requests, in addition to keeping up with your regular work?

For more administrators in the future, the answer may be: turn on your computer.

In a district inservice for Portland, Oreg., principals, Judy Edwards Allen, professor of education at Portland State University, offered these solutions to the above problems:

Item #1. "Using an off-the-shelf microcomputer program for which the generic name is 'spreadsheet' and the trade name is some version of 'Visicalc,' you can play with various versions of the budget in question, changing line items and seeing immediately the effect on the bottom line without hours of tedious work with a calculator. When the budget finally looks like you want it to, you can print it out for your supervisor."

Item #2. "Using the spreadsheet again," Allen noted, "you can develop the necessary projections and can relate them to reality by attaching real cost figures."

Item #3. "Using a word processor at your desk, you can develop your speech, move or delete or insert paragraphs or lines or sentences or words, check your spelling, and print out versions of the speech as it develops. You can store the speech on a diskette and modify or add to it again later for another occasion."

Item #4. "Filing and database programs carrying trade names such as DBMaster, Visifile, PFS, or Data Factory could be useful in meeting the need for a small database," Allen said.

They should be involved in decision making about computerization, too.

- List all of your potential uses of a computer, now and in the foreseeable future. Determine whether computerization is needed at the district or school level, or both.
- Set priorities. Determine, for example, which manually performed tasks that could be computerized require the most work and/or the most time. Keep in mind that you generally must have a good manual procedure for completing a task before you will be able to computerize it.

Consider: If you put junk data into a machine, you will get junk data out. Here's an example of applying this principle, as explained by Jerry Kantlehner in *School Business Affairs*: Suppose you want to computerize administrative details of the custodial service. You will need to determine if inventory data is timely and accurate, if detailed usage and recorded data exist, and if material and labor costs have been established in each area involved.

- Outline what you need to have done regarding each task (e.g., if you are considering purchasing a word processing system, determine the number of users and where they are located, the quantity and kinds of written materials they produce most often, and whether it is for in-house or outside distribution).
- Talk to other schools or districts about their experiences in using computers for administration tasks.
- If you do not have computer expertise, draw on those in the community who do. "In addition to providing informed guidance," notes Sue Talley, former manager of micro systems for the Minnesota School Districts Data Processing Joint Board, "this guarantees that these individuals will accept part of the responsibility for successful implementation."
- Talk to sales personnel. Crawford advises: "The way in which a salesperson approaches you as a customer is very important. Avoid a salesperson who tries to sell you computers; choose one who tries to sell you functions."
- Conduct a cost/benefit analysis for each function being considered for computerization.
- Consider what security methods you will need to assure limited access to data.
- Consider future needs. Keep in mind that it's better to buy hardware that will meet your needs next year, too, rather than considering only what you require right now.

Guidelines: Purchasing Micros

Crawford gives three basic steps to follow in deciding which microcomputer to purchase for administrative purposes:

1. Decide which administrative functions should be automated and in what order of priority.
2. Identify which software best automates these functions.
3. Select the hardware that runs the selected software.

The New Jersey School Boards Association offers some additional "common-sense guidelines" for purchasing and implementing an administrative system in *Micros for Managers: A Software Guide for School Administrators* (the Association, 315 W. State St., P.O. Box 909, Trenton, N.J. 08605; $25 plus $3 for postage). It recommends:

- Fully test the hardware system, configured to meet your specific data retrieval, storage, and manipulation requirements.
- Get an evaluation of your system configuration from other users who have experience with the system.
- Do not buy a hardware system to serve multiple functions, that is, a system for both administrative and instructional purposes.
- Allow sufficient time for the selection/purchasing process. Do not rush into purchasing any hardware/software configuration, no matter what its reputation.
- Do not eliminate old procedures and systems until the new configuration is fully operational. In fact, operate the old and the new in tandem for a substantial period of time before dismantling the old.

The minimum requirements for a microcomputer to be used for administrative purposes, in Crawford's opinion, are: a standard typewriter keyboard, an 80-character wide screen with a diagonal measure of at least 12 inches, a 132-column wide, quality dot-matrix or character impact printer, 64K memory, and two floppy disk drives.

Micros for Managers recommends several optional pieces of hardware for administrative uses: an automatic optical card reader (for test scoring and test analysis applications); and, for scheduling and attendance applications, a hard disk [a microcomputer storage device] with a minimum of 5 megabytes capacity.

Guidelines: Purchasing Software

In terms of software, educational administrators can use the most popular and readily available "general" software packages to perform most administrative jobs. In addition, according to Crawford, there are more than 250 software programs designed specifically for educational administration purposes (e.g., attendance, class scheduling).

Note, however, that Crawford advises administrators to consider buying general software programs rather than those designed to handle specific functions of educational administration.

This general software falls into three categories: data (or database) management systems, electronic spreadsheet systems, and word processing systems. According to Crawford, such software is more effective for several reasons: it can be used for multiple purposes; it allows more flexibility in designing how information is put into the machine and how it comes out; it is available from a local retailer rather than a mail-order supplier; and it is less likely to have "bugs" in it than recently developed educational administration software.

Another point to consider is the *efficiency* of using general purpose software. An example: Using a database management system, information such as student names, addresses, and other data can be typed once and used as a common base for various reports (e.g., attendance, scheduling classes, recording grades). It does not have to be retyped for each separate use.

What about designing and programming a system that precisely meets your needs? Crawford's

An Administrative Model

Possible Applications at the Central Office

- Financial Records and Purchasing
- Maintenance Services
- Certification/Personnel Database
- Staff Development
- Professional Materials Inventory and Circulation
- Word Processing/Mail Lists

Possible Concurrent Uses

- Child Nutrition
- Attendance
- Textbooks
- Substitute Teacher Database
- Community Schools Program

Possible Applications at the Building Level

- Scheduling
- Student Database
- Building Inventory
- Media Inventory and Circulation Systems
- Diagnostic and Prescriptive Programs
- Word Processing/Mail Lists
- Classroom Management
- Report Cards

Source: *State Plan for Computer Utilization in North Carolina Public Schools;* North Carolina Department of Public Instruction, Educational Media and Technology Services.

general advice is to purchase educational administration software rather than to design your own system.

This advice is seconded by Richard Wootton, Arizona State University, Tempe. "Writing your own administrative programs in a high level language is no longer recommended in view of the more cost-effective and excellent software available." He recommends the use of general purpose software, noting that "you need not be a programmer to use it, just moderately accurate on a keyboard, patient, and persistent.

"Even if you buy standardized administrative software," Wootton adds, "almost any school or district should obtain the appropriate spreadsheet, filing system, and word processing programs for the computers which it has. You will discover that they have many uses for saving time and improving operations."

For help in evaluating the software in which you are interested, obtain a copy of these two forms: "Administrative and Instructional Management Package Description" and "Administrative and Instructional Management Package Evaluation." The forms are available from the Northwest Regional Educational Laboratory, 300 S.W. Sixth Ave., Portland, Oreg. 97204.

Note: Crawford periodically updates "The Educational Administrator's Survival Guide to Administrative Use of Microcomputers." Included in the Guide are criteria for evaluating software and hardware and descriptive lists of available software. For more information, contact Chase Crawford, Consultant, Management Information Services, Florida Department of Education, Tallahassee, Fla. 32301.

Tips

✓ Remember that computers are not a cure-all. Dale Hancock, principal of Willis Junior High School, Chandler, Ariz., offers this advice: "With an organized administrator, computers will be efficient. With an unorganized administrator, they will be inefficient."

✓ Beware of the hidden costs of computerizing administrative functions. Examples: training costs for those who will use the system, costs of consultants for needs assessment and initial set-up, maintenance costs, special furniture to accommodate new equipment, insurance.

✓ Purchase hardware and software from a dealer who has a good reputation, an onsite repair capability, and a convenient location.

✓ Don't underestimate the "people problem" in implementing new technology. Some experts recommend gradual conversion, for example, in automating offices. Sue Talley, formerly of the Minnesota School Districts Data Processing Joint Board, advises: "Most often, staff will need training to overcome their apprehension of initial machine use and then specific operational training to use the software as the selection and acquisition committee envisioned. Focus initially on applications which have a high probability of success. . . . Let the success of the initial installation serve as a building block to growth in other areas. Peer communication of success creates interest and desire for productive use."

Talley favors slow implementation so that problems can be corrected while they are small. "Converting the entire clerical staff to the use of word processing may slow production drastically at first," she says. And, no matter who must learn to use the new technology, "they must have time away from regular duties to do so," she adds.

Judy Edwards Allen, professor of education at Portland (Oreg.) State University, offers this guideline: "There is a direct relationship between *comfort* with the computer and the number of hours spent in becoming computer literate." For administrators, "who are used to being leaders," she says, "it's very *uncomfortable* to feel not in control of something (i.e., computers) which is having such a pervasive effect on your school."

But, she adds, only a small number of hours are needed to start to become comfortable with computers. "One way to accomplish this," she notes, "is to take a computer home with you over the weekend and get acquainted in private, then ask questions of your most computer literate teacher. You may wonder, 'How can I be a leader if I have to go to one of my teachers to get literate?'" But, Allen asks, "how can you be the leader if you don't go to the teacher and become literate?"

Chapter VIII

Special Education

Research has shown that in instances where technology is made available, is of good quality, and is used knowledgeably, it has enormous potential for improving the education of handicapped individuals.

James S. Johnson
U.S. Department of Education

The technology today that is of greatest interest in special education is the microcomputer. On the horizon, also with great potential in special education, according to some experts, are: integrated videodisc systems, telecommunications and local area networking, artificial intelligence, and voice recognition and output.

Aleady, almost 6,600 of the nation's school districts use microcomputers to some degree in their special education programs, according to a report issued in November 1983 by Market Data Retrieval, Westport, Conn. The firm also noted that approximately 80,000 special education teachers (or one-third of all those in the U.S.) have access to microcomputers in their schools.

An indicator of the growing availability of microcomputers for special education comes from Education Turnkey Systems, Falls Church, Va. It projected an 800 percent increase in the number of microcomputers available for instructional purposes in special education — from 15,000 in 1982 to 125,000 in 1985. During the same period, the firm predicted, the number of microcomputers for administrative uses in special education would increase 250 percent — from 10,000 to 25,000.

Currently, special educators face many of the same problems as their counterparts in regular education as they try to implement new technology: inadequate knowledge of what's available and what's appropriate for instructional and administrative uses, lack of hardware and software, and not enough trained teachers.

"Special education teachers and students generally are the last to get machines unless they have their own money," Alfred J. Morin of Education Turnkey Systems told a conference sponsored by the Council for Exceptional Children.

Another view is that special education lags behind regular education in the development of software. However, this situation is improving. "In 1981, there were no special education [software] programs and even regular education programs were of poor quality," according to Kim Allard, coordinator of the SECTOR project at Utah State University, Logan. "Now," she said, "the quantity and quality of both have improved." She also noted an increase in the number of adaptive devices on the market, e.g., voice input devices that enable students with little or no control of their limbs to operate a computer by voice command.

One area in which special education is reported to be ahead of regular education is Computer-Managed Instruction (CMI). Virtually all of existing CMI programs for microcomputers, according to Education Turnkey Systems, were designed specifically for special education.

Applications

A federally funded study conducted by SRA Technologies, Arlington, Va., identified three broad categories of use of microcomputers in special education:

1. **Instructional applications:** Computer Assisted Instruction, Computer Managed Instruc-

tion, computer literacy, and computer programming.

2. **Administrative applications:** financial management systems, information management systems, individualized education plans and reports, and word processing and mailing.

3. **Impairment compensation:** sensory, communication, physical control, personal management, and vocational opportunity.

SRA reviewed the use of microcomputers in special education by 100 districts nationwide. It found that: More than three-fourths reported instructional applications; less than one-fourth reported only administrative applications; and one-half reported both administrative and instructional applications.

The researchers then narrowed the 100 districts to 12 for the purpose of developing case studies. In these 12 districts, the researchers found that the most common instructional use of microcomputers in special education was to provide Computer Assisted Instruction (CAI). Word processing software was employed to improve writing skills and to foster eye-hand coordination.

The districts also used microcomputers as communications aids. In one district visited by the researchers, a microcomputer was fitted with a special keyboard grid for a physically impaired student; in another district, microcomputer applications were being developed for students with hearing impairments.

A few of the districts used Computer Managed Instruction as an integral part of the CAI effort or, separately, to measure student achievement and plan instructional objectives.

The researchers were disappointed that they did not find "more innovative or highly targeted" applications for handicapped students — more attempts, for example, to use microcomputers with students with physical or sensory handicaps.

For the most part, the researchers said, administrative applications of microcomputers in special education were confined to record keeping and report generation, word processing, inventory management, and scheduling. Microcomputer-based systems to develop and monitor individualized education programs were either in place or of great interest to the districts.

The researchers identified seven strategies that lead to successful implementation of microcomputers. The task for administrators, they said, is to incorporate these strategies into the special local setting in which special education students are to be taught. The strategies are: (1) acquire computers on an incremental basis over a period of years; (2) appoint a coordinator; (3) formalize staff or user training; (4) involve administrators and teachers in implementation; (5) move as quickly as possible to get the machines working on some useful activity (regardless of the broader curriculum plan); (6) expand uses to include administrative and instructional applications; and (7) define and nurture a microcomputer "system" (i.e., the unit serving an elementary school, a high school, or special education) before trying to coordinate all of the systems.

Three publications are available to describe the researchers' findings and conclusions. For more information, contact Tom Hanley, SRA Technologies, 901 S. Highland St., Arlington, Va. 22204.

What's Being Done

The U.S. Department of Education's Special Education Program is spending about $4 million annually on technology, James S. Johnson, chief of the program's technology and marketing branch, said in an interview for this report.

In fiscal 1984, 12 new federal contracts were awarded to projects to develop, market, and disseminate products and services for special education.

Six awards were made to organizations to create instructional aids from existing electronic components for seriously handicapped persons. Examples:

- A low-cost, portable writing/conversation/computer access unit small enough to carry by ambulatory or wheelchair-bound individuals.
- A general-purpose, adaptive interface connected to a low-cost microcomputer. It will enable the user to access software that is designed to run on higher-cost microcomputers.
- A device that will enable the user, through wireless transmission to a computer, to control the movement of a powered wheelchair as well as operate a communications aid.

Three of the contracts, Johnson said, will increase the availability and quality of microcomputer software designed to individually manage instruction for handicapped students. One project, for example, is developing an authoring system for teachers with little or no computer programming skills so they can develop CAI software for handicapped students.

Under three additional contracts (for fiscal year 1985), the program will fund a software center, a

Resources

Telecommunications network. SpecialNet enables special educators to call a local or toll-free 800 telephone number and connect via computer to its nationwide information system. If offers electronic mail (a system for sending private or group messages instantly via computer) and electronic bulletin boards (which display mail for semi-public or public information). The national bulletin boards cover areas such as vocational education, policy, legislation, and gifted students. Many states also maintain bulletin boards. Contact the National Association of State Directors of Special Education, 1201 16th St., N.W., Suite 404E, Washington, D.C. 20036.

Exemplary practices. The Council of Administrators of Special Education (CASE) identifies annually "unique or exemplary practices in special education," including some which make use of computers and other technology for instructional and administrative purposes. Contact: David Greenburg, Model Exchange and Training Project, CASE, Room 100, Smith Research Center, Indiana U., Bloomington, Ind. 47405.

Software/hardware catalog. The *International Software/Hardware Registry* ($15 plus $2.78 shipping) lists and describes software, hardware, and adaptors for handicapped persons. Other publications include two pamphlets on using computers with handicapped persons and interfacing a handicapped child and an Apple computer. Trace R & D Center, 314 Waisman Center, 1500 Highland Ave., Madison, Wis. 53706.

Software catalog. The *Special Ware Directory* describes microcomputer software available for special education. Developed by LINC Resources, Inc., the guide is available from the Council for Exceptional Children, 1920 Association Dr., Reston, Va. 22091; CEC members, $11.86; others, $13.95. LINC Resources, Inc. (3857 N. High St., Columbus, Ohio 43214) also publishes up-to-date lists of new special education products (e.g., software, audiocassettes, films and filmstrips) which it has helped market.

Information on communications aids, devices, and controls. An example: *Access to Computers for the Physically Handicapped,* a free, 8-page brochure. Prentke Romich Co., 8769 Township Rd. 513, Shreve, Ohio 44676.

Vocational information/evaluations. *Microcomputers: The Voc Ed Connection Resource Handbook* ($10) includes information for vocational teachers on microcomputing applications in seven vocational areas. Also available: *Guidelines for Evaluating Instructional Software in Career/Vocational Programming for the Special Needs Learner,* along with a listing of software related to career/vocational programs for the handicapped (no charge). Patricia L. Sitlington, Vocational Education Services, Indiana U., 840 State Rd. 46 Bypass, Room 111, Bloomington, Ind 47405.

Background. SECTOR provides an information packet, *Specialized Applications for Special Educators* ($15), which includes evaluation forms for IEP and Computer Managed Instruction software, four overviews on adaptive devices and software, and four administrative software overviews. SECTOR, Exceptional Child Center, UMC 68, Utah State University, Logan, Utah 84322.

Software winners. Eight special education programs were first-place winners in a year-long competition sponsored by the Council for Exceptional Children and the Johns Hopkins University. The programs address both instructional and administrative areas of special education. Contact: Lynn Smarte, Council for Exceptional Children, 1920 Association Dr., Reston, Va. 22091.

technical information exchange center, and 20 "mutual growth opportunities."

The *software center* will serve as (1) a clearinghouse for educators who want to find out about available software for specific needs of special education students, and (2) a source of help and information for individuals or companies interested in developing software for use with handicapped children. The center should be ready to provide service, starting about spring 1985.

The *technical information exchange* is intended to help state education agencies and school districts solve problems they may encounter in making decisions about and implementing technology in special education (e.g., where to find funding). Like the software center, the information exchange center should be ready to provide service about spring 1985, according to Johnson.

The *mutual growth opportunities* will enable 20 collaborative projects — each including a state education agency, a school district, and a college or university — to work together in incorporating technology into the district's special education program. Each project could eventually become a model, open for visitation by educators.

For more information on these federal initia-

tives, contact James S. Johnson, Chief, Technology and Marketing Branch, Special Education Program, U.S. Department of Education, 400 Maryland Ave., S.W., Washington, D.C. 20202; 202/732-1123.

What's Available

A number of options, information sources, and other resources are available now to educators who want to use technology for special education.

Administration

According to one source, about 70 administrative software programs were available for special education in early 1984. (Note: The SECTOR project plans to evaluate this software as part of its ongoing evaluation effort. For more details, contact Kim Allard, Project Director, Exceptional Child Center, UMC 68, Utah State University, Logan, Utah 84322.)

Many special education teachers are most interested in using a computer to reduce the paperwork required for Individualized Education Plans (IEPs). This is not only possible, but beneficial to teachers and districts, according to Nancy E. Enell of the San Juan Unified School District, Carmichael, Calif. She based her conclusions on two studies she conducted with support from the California State Department of Education.

One of her major findings is that teacher time, and thus cost, for IEP annual review meetings is shortened by nearly 30 minutes per student when computers are used. Other benefits for teachers and parents, she said, include the production of clear, legible IEP copies. Parents also like the fact that portions of IEPs can be changed easily when they are produced by computer.

The disadvantages of using computers in the IEP process, Enell said, may include cost and the impersonal nature of computers.

The cost, she said, varies with the type of computer equipment and with the amount of information included. Some examples: Enell said that microcomputer programs to produce an IEP facesheet and to store and retrieve administrative data range from $199 to $5,000 (1983 figures) and that programs to develop complete IEPs range from $595 to $6,000.

IEP programs for mainframe computers cost more, she noted, "although they will usually include the ability to produce administrative reports as well as more complete IEPs."

'It's a Miracle!'

That's how some educators and parents describe the first encounter of handicapped students and new technology. Here are some examples:

- **Seven-year-old Jason, quadriplegic, nonverbal, blind, with cerebral palsy, ended a lifetime of isolation when he communicated for the first time with the aid of a special switch connected to a microcomputer.**
- **Another young child, Jasmine, started to communicate understandably with teachers and students after only two months' instruction on a microcomputer with the help of a speech output device. Previously, because of her handicaps (cerebral palsy and impairment of muscles needed for speech), only her parents could understand her.**
- **A learning disabled student whose deficiencies include poor attention span and inability to write with a pen or pencil now uses a word processing program on a microcomputer. The result: accurately typed, organized printouts in place of disorganized, messy scrawl.**
- **Commack, N.Y., kindergartners with poor listening skills learn to follow the teacher's directions and gain skills in problem solving and adding and subtracting by using Big Trak, a programmable vehicle. Other students develop eye-hand coordination as they manipulate paddles connected to a computer to play specially designed learning games.**

Enell suggested these steps for districts interested in using computers to complete IEPs:

1. Start where you are; see if you can simplify what you have (e.g., using more boxes and checkmarks).
2. Become computer literate so you're not befuddled by the technology.
3. Get list of objectives that teachers would use.
4. Determine what hardware resources you have available.
5. Find out what kinds of programs are available to meet your needs.

Enell's findings and recommendations are contained in two reports: *How To Streamline Your IEP* ($2) and *An Examination of the Relative*

Efficiency and Usefulness of Computer-Assisted IEPs ($5; it includes a detailed list of 30 IEP software programs). Available from Nancy C. Enell, San Juan Unified School District, 3738 Walnut Ave., Carmichael, Calif. 95608.

Instruction

Finding and evaluating software suitable for special education students is a difficult job.

One project which can assist special educators with such efforts is SECTOR. Launched in 1981, the project assigns a team of three special educators/reviewers to evaluate each likely program in four areas: content, instructional design, record keeping/management, and ease of use.

By the spring of 1984, SECTOR had evaluated 58 programs in various subject areas for special education students in grades K-12. A packet containing evaluations of all of the programs, along with the SECTOR software evaluation form, is available from the project ($15). Order from SECTOR, Exceptional Child Center, UMC 68, Utah State University, Logan, Utah 84322.

Evaluation tips. Kim Allard, SECTOR coordinator, offers these tips for evaluating software for use with special education students:

- Hands-on experience with a program is required. "Even with the reviews, you don't know it will work for you."
- "Don't try to evaluate software independent of the use you intend for it."
- Use an evaluation form such as that provided by SECTOR "to focus your attention on the things that can meet your needs and to make sure you haven't omitted something."
- "Probably the most important criterion in evaluating software is ease of use. If you can't use it, it's of no use to you — even if it is an excellent program."

Don't Wait

Judy Wilson, coordinator of the Microcomputer Information Coordination Center for the Kansas State Department of Education, urges special educators to use all currently available alternatives in software and hardware with their students.

Wilson cited these alternatives:

1. Some publishers are turning out "adjustable" software. It allows the teacher to alter the program, that is, to set a different rate of presenting material or level of difficulty.
2. Adaptations built into programs by producers or developers to simplify the way a youngster responds (e.g., pressing a single key).
3. Software to supplement basal materials.
4. Programs that allow a teacher to adapt content by using a "mini-authoring" language. Also in this vein are "shell" programs that offer certain features (e.g., good graphics), but that allow the teacher to enter content.
5. "Tool" applications (or adaptive devices) used in conjunction with microcomputers to enable a student to use the machines.
6. Programs that allow voice input or output.

While noting that "it's nice to have editing capability so you can put into a program what you want," Wilson cautions teachers that adding material can be difficult and that "authors tend not to judge self-designed materials as critically as they do commercial products."

Tips

Here are some tips on implementation issues from various sources:

- Special education directors and staff should be involved, along with other faculty, in planning and decision making on the use of technology.
- In planning hardware purchases, consider applications for special education students. Among the applications to be considered, advises Edward J. Cain Jr. of the Commack (N.Y.) Public Schools, is recreational use. "Handicapped students tend to be socially isolated, and the computer can offer meaningful recreation for them," he noted. More advice from Cain: Consider what prosthetic devices can be used with the computer you are interested in. Does it, for example, have the capability of voice input? Also find out if peripheral devices for use in special education are self-contained or connected by wires and cables. "It's expensive if a youngster trips over something and breaks a micro."
- Heavy dependence on reading may negate the usefulness of some software with some special education students.
- Don't rule out games for special education students. Some teachers claim they keep the attention of students and also increase eye/hand coordination.
- You will need to decide whether to separate the regular and special education teachers for staff development activities. One teacher trainer offered this advice: "If mainstreaming is one of your goals, you may want to train both groups of teachers together."

Chapter IX

Other Technologies

The "other technologies" — those others than microcomputers — featured in this chapter do not illustrate the full realm of what's available — or possible. They were selected on the basis of the interests expressed by respondents to the survey for this report and the availability of demonstrations or models that schools could turn to for more information. Descriptions follow.

First, a view of how the more traditional media — radio and TV — compare with computers in use and district priority, as revealed in a study released in 1984.

The Corporation for Public Broadcasting (CPB), in cooperation wtih the National Center for Education Statistics, surveyed a representative sampling of superintendents, principals, and teachers in public and private schools. It details the results in *Availability, Use, and Support of Instructional Media, 1982-83.*

Audio-Radio

CPB found that audio/radio outstripped both television and computers in the percentage of teachers having them available and using them.

The most popular items in the audio-radio category were audio tapes and records. Ninety-seven percent of teachers surveyed said they spent some time each week listening to audiotapes/cassettes; 86 percent indicated use of records; 16 percent reported direct off-air radio use.

Television

Television was available for instruction to approximately 71 percent of all teachers nationwide, about the same percentage as in 1977, according to an earlier CPB survey. Roughly 30 percent were "regular users" of TV. Regular use is proportionately higher among elementary teachers than among secondary teachers. At the elementary level, however, the percentage of teachers who regularly used television declined significantly (from 42 percent in 1977 to 33 percent in 1982-1983).

Eighty-one percent of the teachers with access to television reported some means of off-air recording. The four most common sources of programming were: direct off-air broadcast from a public television station (reported by 67 percent of principals), cassette or videotape (reported by 65 percent), direct off-air broadcast from a commercial television station (60 percent), and cable television (39 percent).

The three curriculum areas for which television programming was most used were science, social science, and language arts and/or reading.

The number of teachers with access to color sets increased from 34 percent in 1977 to 75 percent in 1982-83. At the elementary level, 27 percent of teachers still had access only to black and white sets.

The videocassette recorder has assumed an increasingly important role in schools. Three-fourths of all schools had one or more of the recorders in 1982-83, compared to one-third in 1977. Plans for future expenditures in television were strongest in two areas: videotape libraries and recorders.

Computers

The CPB study confirmed that computers were a higher district priority than television or audio/radio. To illustrate: Superintendents who could break out media budget categories said their districts spent more of these funds (45 percent) on computers than on other media (33 percent), television (15 percent), or audio/radio (7 percent).

Buildings with both television and computers available, moreover, were more apt to have a computer coordinator than a television coordinator. Almost all of the coordinators (for both

television and computers) had other responsibilities — in the library (television coordinators) or in the classroom (computer coordinators).

Computers also dominated inservice training in media, which was offered by 90 percent of the districts. Eight-four percent of those districts reported training in computers; 50 percent, in television; 39 percent, in other media; and 27 percent, in audio/radio. Teachers, moreover, strongly confirmed that they want more training in computers.

For more information or a copy of the report, contact CPB, 1111 16th St., N.W., Washington, D.C. 20036.

Cable TV

What began in the late 1940s as a way for rural areas to receive TV reception is now becoming a "video cornucopia," to use one writer's phrase. Approximately 39 percent of American households were subscribing to cable by mid 1983.

Even though there is uneven distribution of services across the country, the gap is narrowing. The number of cable systems increased from 4,225 to 5,700 between 1980 and mid 1983; the number of homes served more than doubled — from 16 million to 33 million.

For schools, some of the services of cable could meet pressing needs. In a speech before the New England Development Council, Philip Miller of Massachusetts Educational Television outlined what he called the "fundamental" educational cable services:

- A distribution service that can provide teachers with instructional TV programming tailored to meet individual scheduling needs.
- Studio and training facilities that schools can use to establish or expand a curriculum in television production.
- A data network service that interconnects microcomputers used for classroom instruction.
- A data network service that interconnects administrative computers and word processing equipment.
- Channels and production equipment that the school system can use to offer teacher training and inservice workshops from a central location.
- Channels and equipment that the school system can use to promote and publicize school activities.
- Channels and equipment that the school system can use to deliver adult and community education courses to home viewers.

TV and Micro Join Forces To Teach Science

"The Voyage of the Mimi" offers a supplementary science/math program for elementary students in two mediums — TV and microcomputers.

Mimi is a drama about two young scientists and their teenage research assistants studying humpback whales in the Gulf of Maine. Viewers see a 15-minute episode, followed by a related 15-minute documentary "expedition" to an interesting place (e.g., a trip to a Maine shipbuilder, which illustrates the physical and mathematical principles that keep a boat afloat).

Teachers can use the program at the time it is broadcast by the Public Broadcasting System or tape it for off-the-air use later.

A commercial publisher (Holt, Rinehart, and Winston) developed software to further the concepts introduced in Mimi. Some examples: maps and navigation games, an attachment that converts the microcomputer into a laboratory instrument for collecting and displaying data, and games to introduce students to simple Logo "turtle graphics."

The TV portion of Mimi was developed under a $2.65 million federal contract to the Bank Street College of Education.

"If your school district is genuinely interested in two or more of these fundamental services, then cable is worth your investment of time and effort," Miller said.

Even if the district decides not to become involved in cable when the franchise is negotiated, he added, it should make sure that its schools are wired for basic cable reception. If and when it decides it wants to take advantage of cable, the basic connections will be in place.

In an article in *The School Administrator* (April 1984), Dave Bloch, a cable consultant based in Sacramento, Calif., advised districts in communities without a franchise in place to get involved in the selection process. Another of his suggestions is to form a consortium with other educational organizations to ensure that the franchise contains access channels, equipment, and even funding support for the production of educational programming.

"It is important," Bloch says, "to contact city (or county) government departments that are involved with cable as early as possible to make a district's needs and desires known."

Bloch says a successful relationship with the cable operator depends on the language of the franchise contract, the previous relationship between the operator and local government, and the negotiating position and skill of the school administrator.

"The rule of thumb," Bloch adds, "is to ask nicely for anything not required in the franchise — firmly for anything that is."

Here are additional tips from Bloch, Miller, and others:

- Hire or assign a "mini zealot" to follow and participate in the negotiations and to follow through with staff and community once the district is wired.
- Integrate cable and the school curriculum. Ask the people who design and implement your curriculum to assist with the design and implementation of school cable services.
- Don't try to do "exotic" things first; take advantage of what is available. Let the service prove its worth before becoming "too experimental." Check with your state or local program distribution service as to what is available.
- Don't forget that cable isn't just a TV cable. The system can also carry data, voice, and radio signals.
- Make the community aware of the service; at the same time, don't overlook teachers who will have to integrate cable programming into the classroom.
- Establish a broad base of funding and support for educational cable services.
- Provide training to teachers and students who will use the services.
- Evaluate services and make needed changes. Keep records, for example, of how often teachers use the cable service.
- Be prepared for cable system refranchising. Communities use the refranchising process to negotiate a new contract, which includes new or upgraded services.

Helpful Resource: The National Federation of Local Cable Programmers (NFLCP) is a nonprofit membership organization to assist local groups, including schools, in their efforts to gain access to and use cable effectively. It offers publications (a variety dealing with education), a hotline service, consulting, a national convention, and regional conferences. For more information, contact NFLCP, 906 Pennsylvania Ave., S.E., Washington, D.C. 20003.

Here are examples of the uses of cable by some local school districts:

Homework Help; ESL

When schools offer homework assistance as one of their cable TV services, the public responds positively. This is certainly true in Irvine, Calif.

The Irvine Unified School District inaugurated its homework assistance program in February 1983. High school honor students volunteer their services to help other youth with homework on cable television. These volunteers diagram sentences, conjugate verbs, demonstrate long division, and complete chemistry, physics, algebra, and calculus problems "on the air." About 80 percent of the questions pertain to math, said Craig Ritter, district cable coordinator, in an interview for this report.

The result: Hundreds of cable TV subscribers started to tune in Monday through Thursday both to view and to participate in the program. The homework service averages 50-100 calls each night.

The district also telecasts special events such as spelling bees and board meetings twice monthly, with 7th and 8th graders working the equipment.

Another instructional use of the district's cable system is in its ESL (English as a Second Language) program. Irvine's 16,000 students come from 42 different language backgrounds. On a typical day, Chris, an ESL teacher, is animatedly reviewing words and concepts face-to-face (via camera) with students in two different schools. She works from a corner of a district office, questioning, explaining, correcting answers. She carries a full teaching load which includes students in 11 schools.

Ritter, one of the originators of the cable project in Irvine, believes this two-way (interactive) capability is the prime use of the technology for school districts and a "terrific motivator" for participating students. Another plus: It can enable schools to offer subjects such as calculus by making teacher time much more efficient, he said.

Regional Instruction

Four years after the Region IV Education Service Center, Houston, decided to undertake a new regionwide instructional delivery system, it had in place an electronic classroom for the entire region.

The system, called the Interact Instructional Television Network, was made possible when the Center received from the Federal Communications Commission the first new construction permit issued in the United States for a four channel, 50-watt instructional television fixed station (ITFS). It offers one-way video and two-way audio within a 50-mile radius of downtown Houston. The "talk-back" feature is made possible through an FM radio signal. Interact clients include a half-million students and 40,000 employees in 55 school districts. It began telecasting its first program (staff training workshops) in September 1983.

Lynn Hale, Region IV's director of instructional services, said Interact will enable local districts to fulfill the provisions of new state legislation requiring them to offer an honors class when as few as 10 students request it.

"Interact becomes a viable alternative," Hale said, by providing a teacher at a cost that is shared cooperatively by the districts using the service. Offerings include Latin, technical writing, probability, and statistics.

Allen Lewis, Interact's marketing director, said the service offers "mostly honors-type courses for well motivated students." It usually serves small numbers of students in a large number of sites.

The network will offer master's level classes for teachers and administrators in cooperation with two area colleges of education. It will also be joined by four local colleges and universities to provide a variety of credit and noncredit courses to corporations at their sites.

Cooperative Cable

Following a 17-year tradition of sharing first vocational programs and then academic programs, eight school districts in Trempealeau County in western Wisconsin formed a cooperative in 1978 to operate a two-way (coaxial) cable TV hookup. A teacher in one school can communicate with students in the other schools by both video and audio; the students do not leave their schools.

Each participating district has its own cable television channel for instructional television transmission. The schools use the system to expand educational offerings, for inservice training and department conferences, and to cablecast concerts, school plays, sports, and special meetings into homes of cable TV subscribers.

A consortium of four University of Wisconsin campuses, with the help of a $500,000 grant from the Kellogg Foundation, assisted in the programming and development of the system. It also helped train teachers to use cable for instruction.

What's necessary to start and maintain a cooperative program? A spokesman put it this way:

The participating schools must acknowledge a need to share their resources. Further, insular feelings must be replaced by an attitude committed to make it work.

Old rivalries and hard feelings must go. School boards must encourage and support their superintendents as they address and compromise issues with other schools.

. . .Schedule joint meetings of the participating boards several times a year so that they may become acquainted and discuss their concerns and be updated on progress.

. . .Remember, by sharing . . . this is the best way to offer your students the kind of programming they need while retaining your local control.

Satellite Antennas

One of the districts now using a satellite antenna for television reception is the Oakland Schools, Pontiac, Mich. It is hooked up to the district's telecommunications service center, which is equipped with nine videocassette recorders for taping educational programming. The antenna has the potential to receive more than 200 channels from 10 satellites.

The Pontiac district also is equipped to transfer films to tape and will eventually be connected by cable for possible teleconferencing.

At the Alexander Dawson School, located near Boulder, Colo., students installed their own earth station (disk-shaped antenna and associated electronics) to enable the school to receive TV programming via satellite.

"We see satellite communication as a new era in entertainment and education," Oz Gutsche, a school trustee, said. "We wanted to let our students have firsthand knowledge of the technology, and the earth station was a good place to begin."

An article in *T.H.E. Journal* describing the installation notes that the main campus of the school is now wired with a private cable to link all TV sets on campus to the earth station, and that students have responsibility for determinig which plays, debates, educational movies, or governmental shows should be recorded for teachers to use in English, social studies, or science classes.

Electronic Networks

Networks can open a whole new computerized world to educators and students. The key, enabling computers to "talk" to one another over telephone lines, is a modem (modulator-demodulator).

Examples of various kinds of electronic networks follow:

Communications Network

Educators have joined many other professionals in having available electronic networks focused specifically on their interests and communications needs. What this means is that an educator — a school superintendent, for example — can keep up to date on education news and keep in touch with peers by turning on a modem-equipped microcomputer, terminal, or word processor and by dialing an assigned number.

Advantages. Sharon L. Raimondi, senior research associate, Project EduTech, JWK International Corp., described the advantages of belonging to an electronic communications network in *Educational Technology:*

An electronic communication system is most effective as a tool to gather information when human contact is not necessary. A network has several advantages over more traditional forms of communication. First, it links you with a large number of people who share your interests or concerns. Second, communication is facilitated because your messages are sent immediately and usually received the first time — no busy signals or call backs. . . .Third, considering the cost of long-distance telephone calls or postage, electronic communication systems are cost effective. Fourth, you are provided with a wealth of information through established databases, information resources (e.g., bulletin boards), or human resources.

Education groups that now have their own electronic networks include chief state school officers, special education administrators, public relations directors, bilingual educators, and vocational educators, in addition to school administrators.

Networks vary in the services they offer to their users, but most offer at least two common features: electronic mail and information retrieval. An example is provided by ONLINE, AASA's electronic network. Its services include: background, current information, and tips on "hot" issues and pending legislation; a bulletin board featuring news, calendar items, and reports of major events; a job bulletin listing openings for administrators; electronic mail service (enabling subscribers to communicate with AASA and each other); and Education USA Newsline (an education news service provided by the National School Public Relations Association).

ONLINE transmits information via The Source Telecomputing Corp., which offers ONLINE subscribers access to its many services (e.g., airline schedules, UPI news service, consumer information).

For more information and costs of ONLINE, contact Bernard Brill, Director of Marketing, AASA, 1801 N. Moore St., Arlington, Va. 22209; 703/528-0700.

State Networks

Numerous states have in place or are planning electronic networks to link their local school districts. Examples:

- The Florida Legislature approved a multiyear plan to provide data communication links wtih every public institution and school in the state. The network, managed by the Florida Department of Education, offers services such as news from the agency and the state capitol, an electronic mail system, and access to instructional software evaluations.

- Alaska, often cited as a leader in delivering educational services to sparse populations spread over vast open spaces, uses satellite communications, instructional television, audioconferencing, and electronic mail. Its success in using these technologies for educational and community uses led Australia to adopt it as a model for similar purposes. One illustration of technological applications in Alaska: The Learn-Alaska Audioconferencing Network, a joint program of the Department of Education and the University of Alaska. It was making interactive instruction available to students and educators at 268 sites in the spring of 1984.

- West Virginia started its statewide computer network by linking 45 vocational education schools as the first phase of a multiyear plan. Full implementation calls for a microcomputer network for all elementary and secondary schools in the state, affecting not only vocational education but also regular and special education.

Local Network

Everybody wants networking. I think we are unique because we have been able to get our network up and running and are able to show that teachers are using it.

That explanation comes from James Wheeler, director of special education for the Northwest Kansas Educational Service Center, Colby, Kans.

The network developed by Wheeler for special education staffers in 20 school districts served by the Colby Center has already been used as a model by several Kansas districts and by the State Department of Education to develop an intrastate network for its special education administrative units. It was selected by the Council of Administrators of Special Education as one of seven outstanding special education programs in the West in 1983.

In an interview for this report, Wheeler talked about the development of the network.

Using state discretionary special education funding, the project was initially intended to reduce the isolation of 36 special education teachers spread over a 10,000-square-mile area in northwest Kansas.

Staff for the project include Wheeler, an educational coordinator ("an expert on applications who helps teachers after they receive group inservice training"), a "very skilled" programmer (who is also a junior college student), and a data input specialist ("who spends her whole time keeping information up to date").

The project bought hardware (a popular-brand microcomputer, a modem, and a printer) for the 36 special education sites and provided six days of training over two years for the special education teachers joined by the network.

The applications grew as the project became better known, the teachers felt comfortable in using the system, and Wheeler and his staff gained experience in using database services and bulletin boards. Project staff check national electronic services such as SpecialNet on a daily basis and summarize information for local districts. If teachers or administrators want more information, they need only ask (electronically). Similarly, project staff will conduct a search of a national database upon request from a local district. The project prides itself on keeping users up to date on education news. One example: It "downloaded" to the local districts the report of the National Commission on Excellence in Education the day after it was released in Washington.

Special education teachers enter into the microcomputer IEPs (individualized education plans) for each student. Information needed for state collection purposes is taken from the IEPs and becomes part of a database in the Center's computer. This simplifies data collection for each district, the Center, and the state.

The university has tapped the service to run its schedule of classes for teachers and administrators, and to do needs assessments of desired courses. Teachers seeking advanced degrees may confer with their adviser via computer.

Local principals and guidance counselors have also been trained to use the network. And, Wheeler noted, it is now moving toward showing regular education teachers what they can do with the system.

The project, Wheeler said, spurred interest about microcomputers among educators in the whole area. "Now, we probably have the highest ratio in the state," he said.

Information Retrieval Network

Radnor High School, a four-year "highly academic" school located in suburban Philadelphia, believes it was the first high school in the country to explore the instructional use of DIALOG (a bibliographic and information retrieval network) for students and faculty.

Starting about 1980, the high school library added on-line bibliographic searching to its other services "to make students aware that printed indices are not the only access to information," notes Elyse E. Fiebert, head librarian, in *CMC News*. "We wanted students to begin to think in terms of search strategy, specificity of terms, the currency of information, and networking.

"Now," she adds, "this instruction has been integrated into the regular ninth-grade library skills unit."

During the 1982-83 school year, Fiebert says, 545 searches were conducted. Thirty different databases were used, with the choice of database dependent on the subject matter, the goals of the teacher and student, and the academic level.

The school selected the DIALOG service, Fiebert says, "because it was interested in our library philosophy, was looking for new outlets, and had already established a classroom teaching rate arrangement which made this all possible."

The basic hardware components needed are a computer terminal, a printer, and a modem. A CRT (or monitor) is a valuable addition, Fiebert says, for preliminary searching and class demon-

strations. The district absorbs the on-line charges for the service (an estimated $2,000 in 1983-84) as part of its instructional budget.

Electronic Guidance Network

Parents sometimes "lose touch" with the school once their offspring leave elementary school and enter the critical secondary years. But that does not have to be the case, as illustrated by an electronic guidance network operating in the Mountain View-Los Altos (Calif.) Union High School District.

The district's Home-School Computer Network allows parents to electronically check on their youngsters' attendance, grades, and progress toward filling job or college requirements.

Started in September 1983, the future-oriented network was being used by 140 computer-owning families by the end of the school year. The district projects that 90 percent of local residents will have home computers by 1990 and that use of the network will increase accordingly.

Using the network, teachers in the district's two high schools mark attendance for each class on a scanning sheet which is fed into a computer at the end of the day. It can compile student attendance by class, day, marking period, and year. The information can be obtained from the computer upon request.

A parent with a modem-equipped microcomputer can quickly find out if his son or daughter played hooky from school or skipped a class. The parent simply calls the school, "logs on" (gains access) to the school's powerful (20 megabyte) microcomputer, enters a special password and student number, and selects attendance from categories which appear on the home computer monitor. A review of the student's attendance record appears.

In addition, the parent can review his son or daughter's grades and course selections or check them against district requirements for graduation or entrance requirements of the University of California, the State University and Colleges, and community colleges.

What about parents who lack the necessary hardware? The district offers two alternatives: a printout of the computerized information mailed to the home, or the loan of a modem-equipped microcomputer from a school library.

Advantage for students. When a student meets with his or her counselor to choose courses for the following school year, the computer-equipped counselor can hand the student a copy of his or her individualized schedule by the end of the session.

A new software program called Career Paths will enable student, parent, or counselor to quickly obtain from the computer the course requirements needed for a specific job after high school or a specific major at the state colleges or university.

Impact. Parent reaction to the network "has been good," according to Milton Schmidt, director of pupil personnel for the district. He added that the system cuts down by 20 to 30 percent the routine clerical tasks of district counselors (four in one high school, five in the other).

The district also has a much faster turn-around time on attendance reporting (daily instead of weekly), which enables it to enforce a new, stricter attendance policy. All-day unexcused absences — never a large problem — dropped from 7-8 percent to 6 percent; period absences dropped from 8-9 percent to 4-5 percent.

For more information, contact Milton L. Schmidt, director of personnel, Mountain View-Los Altos Union High School District, 1299 Bryant Ave., Mountain View, Calif. 94040.

Videodisc

It's described as "an enigma"; "a technology that may be far ahead of the need"; "high tech versions of the programmed instruction books that were in vogue a few years ago"; "an inexpensive solution that could take the place of, say, a physics lab"; "a breakthrough in instructional technology of potentially revolutionary import to educators."

In its simplest form, the videodisc is a glorified 12" silver record that plays pictures and sound when placed on a videodisc machine connected to a standard television screen. The disc has the power to store 108,000 frames (54,000 per side) which can be scanned and located in seconds with a handheld programmable remote control unit.

Videodisc is being used as a training medium by the military, business executives, corporate learning centers, and computer training firms. Military uses include teaching reading, foreign languages, map reading, and jeep repair.

At the same time, the technology is only slowly gaining acceptance among educators. One reason, according to one expert interviewed for this re-

port: The videodisc is confused with videotape — which it is not — and its potential is not understood. Among the advantages of videodisc cited by experts are its greater information density, better durability, better picture and sound quality, and most importantly, the rapid single frame access that allows a disc to be instructionally programmed or computer driven.

Interactive Video

The American Institutes for Research, Palo Alto, Calif., cited the advantages of combining a videodisc and a computer:

The ability of a teacher to pick up quickly on children's ideas and respond creatively and adaptively to them differentiates expert instruction from the dull and commonplace.

It is very difficult, however, for an individual teacher to respond quickly to each student with appropriate feedback that contains images evoking further exploration by the student, and it is impossible to respond in such a fashion when confronted with an entire classroom of students.

. . . The advent of low cost computing, however, promises to make this kind of interacting feasible. Computers can analyze students' responses extremely quickly and immediately present preprogrammed feedback and extensions that are appropriate for each individual student. There are two important limitations on computers, however. Responses must be in a mode that computers can quickly analyze, at present usually multiple-choice items; and the feedback must either be derived from formula or stored in some form accessible to the computer.

For computers to realize their full potential as tools for education, they must be coupled with devices that push back the current limits on response analysis and increase the size of immediately accessible feedback image storage.

There are a variety of media currently available for storage of information in a form accessible to microcomputers, most notably magnetic tape (including videotape), magnetic disk (floppy disks and hard disks), rotating drums, and videodiscs. They differ from each other in density of storage, ease of storage, and ease of retrieval.

Of these media, the laser videodisc offers perhaps the most exciting option for storage of massive amounts of immediately accessible information. A videodisc player reads information from a rapidly spinning disc by measuring the reflection of a laser beam from its surface. Each revolution of the disc, in one thirtieth of a second, retrieves the information needed to present an entire television picture. It offers unparalleled density of storage and quick scanning to an exact location anywhere on the surface of a disc.

By coupling a videodisc player to a microcomputer, the analysis of a response can be followed by presentation of any of 54,000 'frames' of information, either individually or in a motion sequence.

Videodiscs offer a means for surmouting the barriers that software designers encounter in dealing with large numbers of different topics or items. For example, videodiscs can store entire vocabularies of common words in foreign languages, full color renderings of entire collections in museums full of art objects or species categorizations, and

Electronic Mail

Electronic mail is described as a hybrid between traditional mail and telephone systems, with the typewriter and television screen thrown in. Using electronic mail, one person transmits messages or documents to another person by storing them in a computer system to which both have access. The number of such services is growing dramatically.

The American Institutes for Research (AIR) advises that the value of electronic mail seems to be greatest "for individuals who are working jointly on shared tasks and who need to transmit information in the form of documents that can be retrieved.

"For others," it notes, "the cost effectiveness of electronic mail must be carefully considered." AIR explains that the costs include not only the tangible costs (i.e., for the central computer, the communications system, and the user's hardware and software) but also intangibles such as learning the procedures needed to gain access to the system; learning to read and process information presented on the screen or acquiring a printer; adapting to variability in computer service (sluggish response in peak load, downtime, and changing rules); and learning to type.

extremely rich and detailed images of places, occupations, or skills to be learned.

Examples

Here are two of the available videodiscs developed specifically for education:

The Puzzle of the Tacoma Narrows Bridge Collapse is a much praised videodisc which "offers an intriguing whodunit in physics," according to Dorothy Deringer, former project officer at the National Science Foundation (NSF). It uses dramatic footage of the bridge's collapse into Puget Sound and describes through experiences (for three levels of student abilities) the influence of wind and the importance of physical properties that led to the collapse. It was developed by Robert Fuller and Dean Zollman of the University of Nebraska, with support from NSF.

The *MECC Interactive Economics Course* teaches basic economics to eighth-grade through adult students with a minimum amount of teacher assistance. Its developer, the Minnesota Educational Computing Corp. (MECC), describes it this way: The student works at the center of an active, individualized learning environment which interconnects three technologies: television, computer, and paper and pencil. Working three times a week, 30 minutes at a time, a student can cover the instruction over a period of seven weeks. A student begins a session by opening the appropriate lesson booklet. The printed material lists the lesson objectives, provides a few paragraphs of background material, and then directs the student to turn on the computer. The computer displays additional text materials and some questions to test the student's understanding. At appropriate times, video material is presented from the videodisc player. The computer occasionally directs the student to make notes or to write answers to questions in the booklet. . . . Each session ends in the booklet where the student is directed to turn off the equipment. MECC sees the unit as especially useful to the school district faced with declining enrollment and a tight budget.

In a small pilot study of the use of the course by 44 students in five Minnesota high schools, Allen D. Glenn of the University of Minnesota and Richard A. Pollak and Nancy A. Kozen of MECC reported these findings:

- Students responded in a very positive manner to the learning experience and to the technology.
- The teachers agreed that the combination of a microcomputer, videodisc, and print is a desirable method for some students and in particular course offerings. All of the teachers remarked that students were very motivated to use the materials.

Federal ViM Project

The results of a federally funded project to test the use of videodisc technology for basic skills instruction were less positive than the MECC findings. The federal Videodisc/Microcomputer (ViM) project got under way in fiscal year 1980 when the U.S. Department of Education's Division of Educational Technology introduced videodisc technology to 10 elementary schools in the Washington, D.C., area.

In fiscal 1981, the Division contracted with the American Institutes for Research (AIR) to expand the program to 45 schools in 18 states, to coordinate and evaluate the use of computers and interactive videodisc in the project schools, and to set up an electronic mailbox for their use.

AIR issued its evaluation of the project in December 1983. The results, summarized in one word, were "disappointing."

AIR considers its findings as "tentative"; nevertheless, some conclusions can be drawn to help other schools interested in the use of interactive videodisc or electronic mail.

Schools must have sufficient, reliable equipment. Many of the project schools had only one interactive video unit, and the microcomputer had to be shared for other instructional purposes. In some cases, teachers lost interest in trying to develop interactive lessons because of the limited amount of time they could use the equipment.

Some of the schools lacked printers — a critically important piece of equipment for electronic mail, AIR notes. (AIR initially transmitted its project newsletter electronically, but it subsequently sent the newsletter by traditional mail when staff members at project schools complained of the difficulty of trying to read many lines of type on a video screen.)

Another problem was equipment failure "under the stresses of use by students and movement from classroom to classroom."

Schools need videodiscs appropriate for instruction. Staff members at the project schools were critical of the videodiscs supplied by the federal government (e.g., *Infinity Factory*, a math

series, and *Music . . . Is*, a music education series, both originally developed for television). AIR said these videodiscs had not been developed with the goal of supporting interactive lessons. The exception was the *Whales* videodisc developed by the National Geographic Society. One of the schools reported owning a library of 50 videodiscs, but "all were unanimous in wishing for a greater variety of educationally oriented videodiscs available at reasonable cost."

Staff members require training. Project staff in most of the schools did not know how to make use of the videodiscs. (No manuals or computer courseware to manage interactive lessons were included.) AIR adds: "Although many teachers exerted substantial effort to learn to program in BASIC, they found little success in developing their own lessons by using these discs."

AIR concluded:

. . . Schools can be expected to wait until they see effective interactive videodisc courseware before counting on it for basic skills instruction; in the meantime, they will continue to use videodiscs for presentation of video information much in the way that they use filmstrips.

. . . At about one-third of the [project] schools where there is enthusiastic, stable leadership to develop technological solutions to educational problems, progress is being made. Some schools have made, or are contemplating, their own videodiscs, while others still view the technology as something to be endured.

Outlook

The school market for videodiscs is small — but growing. One sampling of 300 districts found that approximately 15 percent had at least one videodisc unit.

Some analysts tie the future of the videodisc to its sales potential in the home market. In a January 1984 edition, *Business Week* said the popularity of the videocassette recorder (VCR) sent the videodisc business into a tailspin. U.S. sales of videodisc players hit 300,000 units in 1983, according to the magazine, compared to sales of 4 million VCRs in that same year. The magazine notes, however, that the price of some of the best selling discs (of popular movies) have been considerably reduced and that adaptation of the machine for videodisc-based arcade games may assure the future of this technology.

In an interview for this report, AIR's Donald McLaughlin, director of the federally supported ViM project, said he thinks the videodisc will have little impact on instruction "for the next couple of years." But he doesn't write it off for the future. "Schools," he said, "will continue to use new things that will prove useful."

Another view comes from R. Kent Wood, professor and director of Utah State University's Videodisc Innovation Projects, Logan. He said the future of videodiscs "is much brighter at this time [mid 1984] that it was even one year ago. The cost of the equipment is coming down, more materials are available, and there's a much stronger interest among educators." To illustrate the latter point, Wood noted that a "very conservative" Utah school district was in the process of making its first purchase of videodisc equipment for use in 1984-85.

Another noteworthy development: A large project of Systems Impact, Logan, is developing approximately 70 videodiscs for educational use. The first disc, a math assessment in English and Spanish for grades 1-3, is completed. It includes 335 criterion referenced objectives that are correlated with several available textbooks. A high school/junior college science curriculum should be ready by 1987, according to a company spokesman.

At this point, Wood said, "people problems" are more of an impediment than are technology problems to widespread school use of videodisc technology.

He noted that he does not expect the videodisc "to come in like gangbusters." Rather, he said, "it will come in on the shirttails of what's already there" (i.e., microcomputers).

Appendix

Some glossaries of technology terms run to hundreds of pages. The following list, however, provides a basic introduction to the terms associated with computers:

BASIC — An acronym for "beginners all purpose symbolic instruction code." Always written in capital letters, BASIC permits the use of simple English words and common mathematical symbols to perform the necessary arithmetic and logical operations needed in programming microcomputers.

Bug — Error; may be either a programming error or equipment malfunction.

Byte — A group of binary bits. Eight bits is commonly equal to one byte. It takes 8 bits to form one character; so one byte is generally equal to one letter, number, or graphic symbol.

Chip — The heart of a microcomputer, on which thousands of electronic elements are implanted. The chip, made of silicon, is an integrated circuit; it contains all the circuitry to carry out the many computer operations.

Courseware — Instructional materials for the computer, including the program itself (in disk or tape form), and the teacher and student print materials needed for appropriate use.

CPU — The Central Processing Unit controls what the computer does. The arithmetic, control, and logic units do computations and direct functions for the computer.

CRT — The Cathode Ray Tube is similar to a television screen. The CRT usually is accompanied by a keyboard from which information is entered into the computer.

Database — Any uniform collection of data; usually refers to a collection that is stored in a computer for easy and quick retrieval.

Disk — Magnetic coated materials in a 5" or 8" record-like shape on which information and programs are stored. The information is stored randomly and therefore faster than on cassette storage. Sometimes called diskettes or floppy disks.

Disk Drive — A mechanical unit that may be built into the microcomputer case or may be an add-on peripheral which reads and records on a round magnetic surface.

Documentation — A written description of a piece of software or hardware. It gives the directions to operate a program or piece of equipment.

Hardware — The physical equipment that goes into a computer system, consisting of the central processing unit plus all peripherals.

Interface — An electronic circuit used to connect one electrical device to another electronic or mechanical device to allow the flow of data between units; the matching or interconnecting of systems or devices having different functions.

Load — To put information into the computer's memory from mass storage, such as tape or a diskette.

Memory — The integrated circuits of a computer which store information. In microcomputers, they are referred to as random access memory (RAM) and read only memory (ROM).

Microprocessor — An integrated circuit that executes instructions inside the microcomputer. It is the "brain" of the computer.

Modem — A modulator-demodulator is an instrument used for communicating between computers using telephone lines.

Monitor — A video display unit which uses a cathode ray tube to generate characters. It looks much like a normal television set and may be either black and white or color, as well as high or low resolution.

Operating System — The programming in the computer that links the chips and the circuits with the software package. Operating systems differ among the most popular microcomputers. Thus, software that runs on one brand of computer may not run, without modification, on another.

Peripheral Device — A device, such as a printer, mass storage unit, or keyboard, which is an accessory to a microprocessor and which transfers information to and from the microprocessor.

Port — The location on the microcomputer where input and output devices can be connected. The most common type is an RS232 port.

Printer — A peripheral device that collects output data from the microcomputer and prints it on paper.

RAM — Random Access Memory. Any memory which can be written on or read from, in which the memory locations can be accessed in random sequence. RAM can be erased and reprogrammed by the programmer as frequently as necessary. RAM size is expressed as a quantity of bytes such as 4K (4,000 bytes). RAM may be expanded by adding memory chips or memory boards.

ROM — Read Only Memory. It is an integrated circuit on which data or instructions are programmed at the time of manufacture. It cannot be erased or reprogrammed by normal computer operations. The size of ROM is expressed as the quantity of bytes, for example, 12K (12,000 bytes).

Software — The programs and accompanying documentation. Software is stored on tape cassettes, disks, and solid state cartridges. These are permanent methods of storage and are not erased when the computer is turned off. The computer reads the software into its temporary random access memory (RAM) in order to manipulate the data in its functioning.

Source: *Guide to Software Selection Resources: Part One;* Center for Learning Technologies, New York State Education Department, Albany; and Northeast Regional Exchange, Inc., Chelmsford, Mass.

Other AASA Critical Issues Reports

The Role of the Principal in Effective Schools: Problems and Solutions. Principals alone do not have magic powers to create good schools, but they are the "critical agents" who can get things done. This report details: the principal's role as instructional leader and manager; training, selection, and evaluation of principals; and the role of the superintendent and board in helping principals to become more effective. (96pp; 1983; $12.95; Stock No. 021-00839)

Planning for Tomorrow's Schools: Problems and Solutions. This report examines the essential ingredients of effective planning. It offers models and checklists for successful planning; advice on involving staff and community and setting goals and objectives; and a detailed case study. Also included is information on demographics, politics and finance, attracting top-notch teachers, examining the curriculum, and the use of technology. (80pp; 1983; $12.95; Stock No. 021-00832)

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